Water Resources Survey

Part I:

HISTORY OF LAND AND WATER USE ON IRRIGATED AREAS

and

Part II:

MAPS SHOWING IRRIGATED AREAS IN COLORS DESIGNATING THE SOURCES OF SUPPLY

Valley County Montana

Published by

MONTANA WATER RESOURCES BOARD

Helena, Montana — June, 1968

3

WATER RESOURCES SURVEY

VALLEY COUNTY
MONTANA

Part I
History of Land and Water Use
on Irrigated Areas

MONTANA

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June, 1968

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MONTANA STATE AGRICULTURAL EXPERIMENT STATION

C. C. Bowman, Irrigation Engineer and Consultant, Bozeman

June, 1968

Honorable Tim M. Babcock
Governor of Montana
Capitol Building
Helena, Montana

Dear Governor Babcock:

Submitted herewith is a consolidated report on a survey of Water Resources for Valley County, Montana.

The report is divided into two parts: Part I consists of history of land and water use, irrigated lands, water rights, etc., and Part II contains the township maps in the County showing in colors the lands irrigated from each source or canal system.

Surveys have been made in the counties of Big Horn, Blaine, Broadwater, Carbon, Carter, Cascade, Chouteau, Custer, Deer Lodge, Fallon, Flathead, Gallatin, Golden Valley, Granite, Hill, Jefferson, Judith Basin, Lake, Lewis and Clark, Lincoln, Madison, Meagher, Missoula, Musselshell, Park, Phillips, Pondera, Powder River, Powell, Ravalli, Rosebud, Silver Bow, Stillwater, Sweet Grass, Teton, Treasure, **Valley**, Wibaux, Wheatland, and Yellowstone. Reports are available for all of the counties except a few of the ones which were surveyed a number of years ago and these are now out of print. However, reports will again be published on these counties sometime in the future after they have been updated.

The office files contain minute descriptions and details of each individual water right and land use, which are too voluminous to be included herein. These office files are available for inspection to those who are interested.

The historical data on water rights contained in these reports can never become obsolete. If new information is added from time to time as new developments occur, the records can always be kept current and up-to-date.

Respectfully submitted,

E. V. DARLINTON, Director

Montana Water Resources Board

ACKNOWLEDGMENTS

A survey and study of water resources involves many phases of both field and office work in order to gather the necessary data to make the information complete and comprehensive. Appreciation of the splendid cooperation of various agencies and individuals who gave their time and assistance in aiding us in gathering the data for the preparation of this report is hereby acknowledged.

VALLEY COUNTY OFFICIALS

Maurice Arnold, County Commissioner

Earl Daley, County Commissioner — John Maxness, County Commissioner

Mrs. Mary Lou Eide, Clerk and Recorder

Mrs. Blanche Grotjan, Clerk of District Court — Mrs. Florence P. Walker, Assessor

OTHER AGENCIES AND INDIVIDUALS

Robert G. Dunbar	Professor of History, Montana State University
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Dr. Ralph H. King	Chief of Information Service Montana Bureau of Mines and Geology and other members of the Bureau staff
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Harry Benzinger	Secretary, Glasgow Irrigation District Malta Irrigation District
John W. Black	Secretary, Rock Creek Canal Company

TABLE OF CONTENTS

VALLEY COUNTY

FOREWORD

SURFACE WATER

Our concern over surface water rights in Montana is nearly a century old. When the first Territorial Legislature, meeting in Bannack, adopted the common law of England on January 11, 1865, the Territory's legal profession assumed that it had adopted the Doctrine of Riparian Rights. This doctrine had evolved in England and in the eastern United States where the annual rainfall is generally more than twenty inches. It gave the owners of land bordering a stream the right to have that stream flow past their land undiminished in quantity and unaltered in quality and to use it for household and livestock purposes. The law restricted the use of water to riparian owners and forbade them to reduce appreciably the stream flow, but the early miners and ranchers in Montana favored the Doctrine of Prior Appropriation which permitted diversion and diminution of the streams. Consequently, the next day the legislature enacted another law which permitted diversion by both riparian and non-riparian owners. Whether or not this action provided Montana with one or two definitions of water rights was not settled until 1921 when the Montana Supreme Court in the Mattler vs. Ames Realty case declared the Doctrine of Prior Appropriation to be the valid Montana water right law. "Our conclusion," it said, "is that the common law doctrine of riparian rights has never prevailed in Montana since the enactment of the Bannack Statutes in 1865 and that it is unsuited to the conditions here. . . ."

The appropriation right which originated in California was used by the forty-niners to divert water from the streams to placer mine gold. They applied to the water the same rules that they applied to their mining claims—first in time, first in right and limitation of the right by beneficial use. Those who came to Montana gulches brought with them these rules, applying them to agriculture as well as to mining.

The main points of consideration under the Doctrine of Prior Appropriation are:

1. The use of water may be acquired by both riparian and non-riparian landowners.

2. It allows diversion of water regardless of the reduction of the water supply in the stream.

3. The value of the right is determined by the priority of the appropriation; i.e., first in time is first in right.

4. The right is limited to the use of the water. Stream waters in Montana are the property of the State and the appropriator acquires only a right to their use. Moreover, this use must be beneficial.

5. A right to the use of water is considered property only in the sense that it can be bought or sold; its owner may not be deprived of it except by due process of law.

The State Legislature has provided methods for the acquisition, determination of priority and administration of the right. No right may be acquired on a stream without diversion of water and its application to a beneficial use. On unadjudicated streams, the Statutes stipulate that the diversion must be preceded by posting a notice at a point of intended diversion and by filing a copy of it within 20 days in the county clerk's office of the county in which the appropriation is being

made. Construction of the means of diversion must begin within 40 days of the posting and continue with reasonable diligence to completion. However, the Montana Supreme Court has ruled that an appropriator who fails to comply with the Statutes may still acquire a right merely by digging a ditch and putting the water to beneficial use.

To obtain a water right on an adjudicated stream one must petition the District Court having jurisdiction over the stream for permission to make an appropriation. If the other appropriators do not object, the court gives its consent and issues a supplementary decree granting the right subject to the rights of the prior appropriators.

Montana laws do not require water users to file official records of the completion of their appropriations; therefore, it becomes advisable as soon as the demand for the waters of a stream becomes greater than its supply, to determine the rights and priorities of each user by means of an adjudication or water right suit. This action may be initiated by one or more of the appropriators who may make all the other claimants parties to the suit. The Judge of the District Court then examines all of the claims and issues a decree establishing priority of the right of each water user and the amount of water he is entitled to use. The court decree becomes in effect the deed of the appropriator to his water right.

Whenever scarcity of water in an adjudicated stream requires an allocation of the supply according to the priority of rights, the Judge, upon petition of the owners of at least 15 percent of the water rights affected, must appoint a water commissioner to distribute the water. Chapter No. 231, Montana Session Laws 1963, Senate Bill 55 amended Section 89-1001 R.C.M. 1947, to provide that a water commissioner be appointed to distribute decreed water rights by application of fifteen percent (15%) of the owners of the water rights affected, or, under certain curcumstances at the discretion of the Judge of the District Court—"**provided that when petitioners make proper showing they are not able to obtain the application of the owners of at least fifteen percent (15%) of the water rights affected, and they are unable to obtain the water to which they are entitled, the Judge of the District Court having jurisdiction may, in his discretion, appoint a water commissioner.**" After the Commissioner has been appointed the Judge gives his instructions on how the water is to be apportioned and distributed in accordance with the full terms of the decree.

The recording of appropriations in local courthouses provides an incomplete record of the water rights on unadjudicated streams. In fact, the county records often bear little relation to the existing situation. Since the law places no restriction on the number or extent of the filings which may be made on an unadjudicated stream, the total amount of water claimed is frequently many times the available flow. There are numerous examples of streams becoming over appropriated. Once six appropriators each claimed all the water in Lyman Creek near Bozeman. Before the adjudication of claims to the waters of Prickly Pear Creek, 68 parties claimed thirty times its average flow of about 50 c.f.s. Today, the Big Hole River with an average flow of about 1,000 c.f.s. has filings totaling 173,912 c.f.s. One is unable to distinguish in the county courthouses the perfected rights from the unperfected ones since the law requires no official recording of the completion of an appropriation. Recognition by the courts of unrecorded appropriations adds to the incompleteness of these records. To further complicate the situation, appropriators have used different names for the same stream in their filings. In Montana, many of the streams are found distributed in two or more county courthouses. Anyone desirous of determining appropriations on a certain river or creek finds it difficult and expensive to examine records in several places. In addition, the records are sometimes scattered because the original nine counties of 1865 have now increased to 56. As the original counties

have been divided and subdivided, the water right filings have frequently not been transcribed from the records of one county to the other. Thus, a record of an early appropriation in what is at present Powell County may be found in the courthouse of the original Deer Lodge County.

It can readily be seen that this system of recording offers little protection to rights in the use of water until they are determined by adjudication. In other words, an appropriator does not gain clear title to his water right until after adjudication, and then the title may not be clear because the Montana system of determining rights is also faulty. In the first place, adjudications are costly, sometimes extremely costly when they are prolonged for years. It is estimated that litigation over the Beaverhead River, which has lasted more than twenty years, has cost the residents of the valley one-half million dollars. In the second place, unless the court seeks the advice of a competent irrigation engineer, the adjudication may be based upon inaccurate evidence; in the third place, if some claimant has been inadvertently left out of the action, the decree is not final and may be reopened for consideration by the aggrieved party. Another difficulty arises in determining the ownership of a water right when land under an adjudicated stream becomes subdivided in later years and the water is not apportioned to the land by deed or otherwise. There is no provision made by law requiring the recording of specific water right ownership on deeds and abstracts.

The Legislative Session of 1957 passed Chapter 114 providing for the policing of water released from storage to be transmitted through a natural stream bed to the place of use. The owner of the storage must petition the court for the right to have the water policed from the storage reservoir to his place of use. If there are no objections the court may issue the right and appoint a water commissioner to distribute the water in accordance therewith. This law applies only to unadjudicated streams.

Administration of water on adjudicated streams is done by the District Court, but it has its drawbacks. The appointment of a water commissioner is often delayed until the shortage of water is acute and the court frequently finds it difficult to obtain a competent appointee for so temporary a position. The present administration of adjudicated streams which cross the county boundaries of judicial districts creates problems. Many of the water decrees stipulate head gates and measuring devices for proper water distribution, but in many instances the stipulation is not enforced, causing disagreement among water users.

Since a water right is considered property and may be bought and sold, the nature of water requires certain limitations in its use. One of the major difficulties encountered after an adjudication of a stream is the failure of the District Court to have control over the transfer of water rights from their designated places of use. The sale and leasing of water is becoming a common practice on many adjudicated streams and has created serious complications. By changing the water use to a different location, many of the remaining rights along the stream are disrupted, resulting in a complete breakdown of the purpose intended by the adjudication. Legal action necessary to correct this situation must be initiated by the injured parties as it is their responsibility and not that of the court.

At one time or another all of the Western Reclamation States have used similar methods of local regulation of water rights. Now all of them, except Montana, have more or less abandoned these practices and replaced them by a system of centralized state control such as the one adopted by the State of Wyoming. The key characteristics of the Wyoming system are the registration of both the initiation and completion of an appropriation in the State Engineer's Office, the determin-

ation of rights and administration by a State Board of Control headed by the State Engineer. These methods give the Wyoming water users title to the use of water as definite and defensible as those which they have to their land.

When Montana began to negotiate the Yellowstone River Compact with Wyoming and North Dakota in 1939, the need for some definite information concerning our water and its use became apparent. The Legislature in 1939 passed a bill (CH. 185) authorizing the collection of data pertaining to our uses of water and it is under this authority that the Water Resources Survey is being carried on. The purpose of this survey is: (1) to catalogue by counties in the office of the State Engineer, all recorded, appropriated, and decreed water rights including the use rights as they are found; (2) to map the lands upon which the water is being used; (3) to provide the public with pertinent water right information on any stream, thereby assisting in any transaction involving water; (4) to help State and Federal agencies in pertinent matters; (5) to eliminate unnecessary court action in water right disputes; and (6) to have a complete inventory of our perfected water rights in case of need to defend these rights against the encroachments of lower states, or Wyoming or Canada.

GROUND WATER

Ground water and surface water are often intimately related. In fact, it is difficult in some cases to consider one without the other. In times of heavy precipitation and surface runoff, water seeps below the land surface to recharge reservoirs which, in turn, discharge ground water to streams and maintains their flow during dry periods. The amount of water stored underground is far greater than the amount of surface water in Montana, and, without seepage from underground sources it is probable that nearly all the streams in the state would cease to flow during dry periods.

It is believed that Montana's ground water resources are vast and only partly developed. Yet, this resource is now undergoing accelerated development as the need for its use increases and economical energy for pumping becomes available. Continued rapid development without some regulation of its use would cause a depletion of ground water in areas where the recharge is less than the withdrawal. Experience in other states has shown that once excessive use of ground water in a specific area has started, it is nearly impossible to stop, and may result in painful economic readjustments for the inhabitants of the affected area.

Practical steps aimed at conserving ground water resources as well as correcting related deficiencies in surface water laws became necessary in Montana. Prior to the Legislative Session of 1961, there was no legal method of appropriating ground water. Proposed ground water codes were introduced and rejected in four biennial sessions of the Montana Legislative Assembly—1951, 1953, 1955, and 1959.

In 1961, during the 37th Legislative Session, a bill was introduced and passed creating a Ground Water Code in Montana (Chapter 237, Revised Codes of Montana, 1961). This bill became effective as a law on January 1, 1962, with the State Engineer designated as "Administrator" to carry out provisions of the Act. However, the 1965 Legislature abolished the office of the State Engineer and transferred his duties to the State Water Conservation Board, effective July 1, 1965. On July

1, 1967, the name of the State Water Conservation Board was changed to the Montana Water Resources Board. Therefore, the Montana Water Resources Board became the "Administrator" of this Act.

Some of the important provisions contained in Montana's Ground Water Law are:

Section 1. **Definition or Regulations As Used in the Act.**

(a) "Ground Water" means any fresh water under the surface of the land including the water under the bed of any stream, lake, reservoir, or other body of surface water. Fresh water shall be deemed to be the water fit for domestic, livestock, or agricultural use. The Administrator, after a notice of hearing, is authorized to fix definite standards for determining fresh water in any controlled ground water area or sub-area of the State.

(b) "Aquifer" means any underground geological structure or formation which is capable of yielding water or is capable of recharge.

(c) "Well" means any artificial opening or excavation in the ground, however made, by which ground water can be obtained or through which it flows under natural pressures or is artificially withdrawn.

(d) "Beneficial use" means any economically or socially justifiable withdrawal or utilizations of water.

(e) "Person" means any natural person, association, partnership, corporation, municipality, irrigation district, the State of Montana, or any political sub-division or agency thereof, and the United States or any agency thereof.

(f) "Administrator" means the Montana Water Resources Board of the State of Montana.

(g) "Ground Water area" means an area which, as nearly as known facts permit, may be designated so as to enclose a single distinct body of ground water, which shall be described horizontally by surface description in all cases and which may be limited vertically by describing known geological formations, should conditions dictate this to be desirable. For purpose of administration, large ground water areas may be divided into convenient administrative units known as "sub-areas."

Section 2. **Right to Use.**

Rights to surface water where the date of appropriation precedes January 1, 1962, shall take priority over all prior or subsequent ground water rights. The application of ground water to a beneficial use prior to January 1, 1962, is hereby recognized as a water right. Beneficial use shall be the extent and limit of the appropriative right. As to appropriations of ground water completed on and after January 1, 1962, any and all rights must be based upon the filing provisions hereinafter set forth, and as between all appropriators of surface or ground water on and after January 1, 1962, the first in time is first in right.

Any ground water put to beneficial use after January 1, 1962 **must** be filed with the County Clerk and Recorder in the county where the ground water is withdrawn in order to establish a right to use of the water.

Montana's Ground Water Code now provides for three different types of forms available for filing water rigbts depending upon the nature of the ground water development. The old Form No. 4 became invalid after January 1, 1966.

Form No. 1 **"Notice of Appropriation of Ground Water"**—shall require answers to such questions as (1) the name and address of the appropriator; (2) the beneficial use for which the appropriation is made, including a description of the lands to be benefited if for irrigation; (3) the rate of use in gallons per minute of ground water claimed; (4) the annual period (inclusive dates) of intended use; (5) the probable or intended date of first beneficial use; (6) the probable or intended date of commencement and completion of the well or wells; (7) the location, type, size, and depth of the well or wells contemplated; (8) the probable or estimated depth of the water table or artesian aquifer; (9) the name, address, and license number of the driller engaged; and (10) such other similar information as may be useful in carrying out the policy of this Act. This form is optional but it has an advantage in that after filing the Notice of Appropriation, a person has 90 days in which to commence actual excavation and diligently prosecute construction of the well. Otherwise, failure to file the Notice of Appropriation deprives the appropriator of his right to relate the date of the appropriation back upon filing the Notice of Completion. (Form No. 2)

Form No. 2 **"Notice of Completion of Ground Water by Means of Well"**—this form shall require answers to the same sort of questions as required by Form No. 1 (Notice of Appropriation of Ground Water), except that for the most part it shall inquire into accomplished facts concerning the well or means of withdrawal, including (a) information as to the statis level of water in the casing or the shut-in pressure if the well flows naturally; (b) the capacity of the well in gallons per minute by pumping or natural flow; (c) the approximate drawdown or pumping level of the well; (d) the approximate surface elevation at the well head; (e) the casing record of the well; (f) the drilling log showing the character and thickness of all formations penetrated; (g) the depth to which the well is drilled; and similar information.

It shall be the responsibility of the driller of each well to fill out the Form No. 2, "Notice of Completion of Ground Water by Means of a Well," for the appropriator, and the latter shall be responsible for its filing.

Form No. 3 **"Notice of Completion of Ground Water Appropriation Without a Well"**—is for the benefit of persons obtaining (or desiring to obtain) ground water without a well, such as by sub-irrigation or other natural processes so as to enable such persons to describe the means of using ground water; to estimate the amount of water so used; and requiring such other information pertinent to this particular type of ground water use.

Montana's Ground Water Code, as amended by the 1965 Legislature, provides for a period of four (4) years after January 1, 1962 for filing on vested ground water rights (all ground water used prior to January 1, 1962 from water wells, developed springs, drain ditches, sub-irrigation, etc.). Therefore, the deadline was December 31, 1965. A person did not lose his vested ground water rights by failure to file within the four-year period although, in the event of a future ground water dispute, he may be called upon to prove his rights in court. If a person files now on ground

water developed prior to January 1, 1962, his date of priority becomes the date of filing, rather than the date when the water was first used.

It shall be recognized that all persons who have filed a Water Well Log Form as provided for under Section 1 and 2 of Chapter 58, Session Laws of Montana, 1957, shall be considered as having complied with the requirements of this Act.

It is important to note that the ground water law states, **"Until A Notice of Completion (form #2 or #3) is filed with respect to ANY use of ground water instituted AFTER January 1, 1962, NO right to that use of water shall be recognized."**

Copies of the forms used in filing on ground water are available in the County Clerk and Recorder's Office in each of Montana's 56 counties. It shall be the duty of the County Clerk in every instance to file the original copy of the county records; transmit the second copy to the Administrator (Montana Water Resources Board); and the third copy to the Montana Bureau of Mines and Geology; and the fourth copy to be retained by the appropriator (person making the filing).

Accurate records and the amount of water available for future use are essential in the administration and investigation of water resources. In areas where the water supply becomes critical, the ground water law provides that the administrator may define the boundaries of the aquifer and employ inspectors to enforce rules and regulations regarding withdrawals for the purpose of safeguarding the water supply and the appropriators (see wording of the law for establishing a "controlled area").

The filing of water right records in a central office under control of a responsible State agency, provides the only efficient means for the orderly development and preservation of our water supplies and it protects all of Montana's use—on both ground and surface water.

METHOD OF SURVEY

Water resources data contained in Part I and Part II of this report are obtained from courthouse records in conjunction with individual contacts with land owners. A survey of this type involves extensive detailed work in both the office and field to compile a comprehensive inventory of water rights as they apply to land and other uses.

The material of foremost importance used in conducting the survey is taken from the files of the county courthouse and the data required includes: landownership, water right records (decrees and appropriations), articles of incorporation of ditch companies and any other legal papers concerning the distribution and use of water. Deed records of landownership are reviewed and abstracts are checked for water right information when available.

Aerial photography is used by the survey to assure accuracy in mapping the land areas of water use and all the other detailed information which appears on the final colored township maps in Part II. Section and township locations are determined by the photogrammetric system, based on government land office survey plats, plane-table surveys, county maps and by "on-the-spot" location

during the field survey. Noted on the photographs are the locations of each irrigation system, with the irrigated and irrigable land areas defined. All the information compiled on the aerial photo is transferred and drawn onto a final base map by means of aerial projection. From the base map, color separation maps are made and may include three to ten overlay separation plates, depending on the number of irrigation systems within the township.

Field forms are prepared for each landowner showing the name of the owner and operator, photo index number, a plat defining the ownership boundary, type of irrigation system, source of water supply and the total acreage irrigated and irrigable under each. All of the appropriated and decreed water rights that apply to each ownership are listed on the field forms with the description of intended place of use. During the field survey, all water rights listed on the field form are verified with the landowner. Whenever any doubt or complication exists in the use of a water right, deed records of the land are checked to determine the absolute right and use.

So far as known, this is the first survey of its kind ever attempted in the United States. The value of the work has become well substantiated in the counties completed to date by giving Montana its first accurate and verified information concerning its water rights and their use. New development of land for irrigation purposes by State and Federal agencies is not within the scope of this report. The facts presented are found at the time of completion of each survey and provide the items and figures from which a detailed analysis of water and land use can be made.

The historical data contained in these reports can never become obsolete. If new information is added from time to time as new developments occur the records can always be kept current and up-to-date.

Complete data obtained from this survey cannot be included in this report as it would make the text too voluminous. However, if one should desire detailed information about any particular water right, lands irrigated, or the number and amount of water rights diverting from any particular stream, such information may be obtained by writing the Montana Water Resources Board in Helena.

Every effort is being made to ensure accuracy of the data collected rather than to speed up the work which might invite errors.

WATER RESOURCES SURVEY

Valley County, Montana

PART I

History of Land and Water Use
On Irrigated Areas

Published by

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HISTORY AND ORGANIZATION

Valley County and the area surrounding it was first viewed by white men in 1743, when the French fur-exploring Verendrye party came into the region. The next authentic observation of this area by white men was recorded in the record of Meriwether Lewis of the Lewis and Clark Expedition. To delve further back into the history of this land, it was once the domain of the Gros Ventre and Assiniboine Indians and it contained all manner of wildlife, including thundering herds of buffalo. In this area were unbelievable stretches of land, covered with lush free grass to lure the hungry herds of longhorn cattle from Texas, before the coming of the railroad, the homesteader, and the barbed wire.

After the Lewis and Clark Expedition, the area was viewed by such explorers as Scientist-Artist George Catlin in 1832, and the Rhenish Prussian scientist, Alexander Philip Maximilian, who was accompanied by the Swiss artist Karl Bodmer in 1833. The upper Missouri River region was thoroughly explored and documented by these men.

In 1843 came the famed naturalist, John James Audubon, and ten years later the most significant of all, Isaac I. Stevens and his northern transcontinental railway survey party. Assisting both Audubon and Stevens as a guide, interpreter, and general trouble shooter was Alexander Culbertson, a man who played an important part in the Montana fur trade and history of Eastern Montana.

The earliest trading post in Valley County is said to have been near present-day Vandalia, which was referred to by Governor Stevens as Hammell's Houses. Later it was called Cambell's Houses and was said to have been owned by the I. G. Baker firm of Fort Benton and managed by W. G. Conrad, who later became one of Montana's leading businessmen and bankers.

Most of the trading posts in what is now Valley County were not built until after 1860 and none had more than a transitory existence. All were roughly built of logs, and the vagaries of the Missouri River have long since destroyed any of their physical remains. One of these forts—Old Fort Peck—lives on as the name of the Indian reservation now occupied by the once mighty Assiniboine and Sioux, and as the name of one of the world's greatest dams.

In 1860, a trading post was built at the mouth of the Milk River by a professional hunter named Louis Dauphin. Two years later Charles Larpenteur established Fort Galpin for the American Fur Company on the north bank of the Missouri River just above the mouth of the Milk. The Milk River was named by Lewis and Clark because of its peculiar whiteness, such as might be produced by a tablespoon of milk in a cup of tea. Fort Galpin was named for Charles E. Galpin, an early day trading post employee and trapper, who was also known as "Major" Galpin, although he was not connected with the military in any way.

One of the last trading posts in the Valley County area was Fort Peck which was built during the winter of 1866-1867. Fork Peck was never known as a military post, although an occasional detachment of soldiers stopped there while escorting a freight outfit through the Indian country. It was built by the firm of Durfee and Peck and consisted of warehouses, stables, a blacksmith shop, and cabins for the men, all of which were built of cottonwood logs and enclosed by a square stockade with two bastions. The fort was located about 2½ miles above the Big Dry on the north side of the Missouri River near Spread Eagle Bar, close to the water intake tower where the present town of Fort Peck is located. The man in charge of constructing Fort Peck was Abe Farwell, an

employee of Durfee and Peck. Durfee and Peck staffed the fort with a trader, interpreters, and laborers, consisting of not more than 15 or 20 men at any one time. The fort was frequently visited by hunters who came by the score into this area to hunt game, especially buffalo, during the 1860s and 1870s.

Old Fort Peck declined rapidly after its abandonment in 1879. The last remnants of its log buildings remembered by early day pioneers were removed by an ice gorge in the spring of 1918.

Cattle played an important part in the early life and development of the Valley County area. The cattle era began when the Indian tribes were restrained and settled on reservations, and the buffalo killed, (the last ones killed in this area was in 1885 on Cherry Creek) leaving the range clear for the coming of the cattle from Texas to feed on the free grasses of northeastern Montana. Here in northeastern Montana were thousands of acres of grassland extending north from the Missouri River to the Canadian line, and it so intrigued the cattlemen as a new potential free range, that they sent T. C. Power (of Fort Benton, businessman and steamboating fame) to Washington in 1886 to work toward opening the Indian Reserve. Congressman Joseph K. Toole also worked on the project, and in 1888, the land on which buffalo had ranged only a short time before was opened as unreserved public domain. There were no provisions for selling or leasing any of the range land and it was used by cattlemen as open range for thousands of head of cattle they owned.

One of the largest cattle ranches in Valley County was the N-N brand of the Niedringhaus Brothers of St. Louis who had established their Home Land and Cattle Co. in Canada's Woody Mountains. During the 1880s they operated two big ranches in this vicinity, one on Rock Creek and the other south of the Missouri River on the Little Dry. In 1895 their operations were moved to Oswego.

The N-N employed many cowboys who later became Valley County residents and in some cases became ranchers on their own. The N-N is said to have paid taxes on 100,000 head in 1891, the cattle ranging in present Valley, Custer and Dawson Counties. Even in the panic year of 1893 the N-N worked eleven wagons on round-up and shipped 23,000 head of cattle to the Chicago markets.

Mention should be made of the Circle Diamond brand of the Bloom Land and Cattle Company of Colorado which, in 1885 sent 21-year-old John Survant to Montana to look for range grass. Survant, who was later nominated to the Cowboy Hall of Fame, established ranch headquarters six miles north of Malta in 1892. At one time the Circle Diamond brand claimed all the range land from Chinook to Hinsdale and from the Milk River to Canada.

Space does not permit listings of all the ranch operations in Valley County, but to mention a few, here is a brief run down on some of the well known ranch operators. The Hand Brothers, Henry, Charles and Walter, who started a cattle ranch on Willow Creek in 1889; the Durell Brothers of Nashua, who began operations in the 1880s; the Slaughter and Kyle ranch, started on Larb Creek early in the 1890s; the George White ranch on Antelope Creek in 1891; the Henry Johnson ranch, started on Willow Creek in 1900, and the J. B. Long Co., headed by the brother-in-law of the founder of Armour and Co., which sheared as high as 100,000 head of sheep in this area.

The largest cooperative roundup ever held near Glasgow was reported by the Gazette on July 28, 1894. The round-up was accompanied by 350 head of horses and began on the Little Porcupine, then worked west and eventually took in all the country between the Missouri and the Canadian

line. Participating were: Johnnie Survant of the Circle Diamond, Los Blackman of the N-N, T. H. Daly of the DHS, Lou Kennedy of D-K, Billy Titus of the 79 Ranch, Cal Schuler of the Shonkin, Billy Buzzard of the XIT, and Bill Willis and D. C. Kyle of the Circle Dot.

Although the cattle industry is still vitally important to the economy of northeastern Montana it was obvious that the open range in Montana was coming to a close. The severe winter of 1886-1887 sounded the death knell of the open range cattle era in most of Montana, and the extremely cold winter of 1906-1907 ended it in this last hold-out of the big cattle outfits. The weekly press of Glasgow that year was filled with accounts of the large number of cattle and sheep that were either frozen or starved to death.

It was on Saturday, July 23, 1887, that the track-layers for Jim Hill's railroad arrived at a point about two miles east of where the Great Northern Depot in Glasgow now stands. The point was called Siding No. 45, the sidings having been consecutively numbered westward from Minot, North Dakota. In October, 1887, a clerk working in the railroad's St. Paul office, seeking to honor the famed Scottish city, named the siding Glasgow. Glasgow's early growth was in direct proportion to that of the railroad. By November, 1888, the St. Paul, Minneapolis and Manitoba Railway (later named the Great Northern) was running separate freight and passenger trains. The same year the box car depot at Glasgow was replaced by a trim frame building, a five-stall round-house was built and operators of tent saloons and restaurants had either departed or permanent structures (many of them log) replaced them.

It was in 1893 that the town of Glasgow was affected by a momentous event; the creation of Valley County out of old Dawson County, and the naming of Glasgow as the county seat. Governor John E. Richards signed the bill creating the new county out of all that portion of Dawson County lying north of the Missouri River to the Canadian line and that part 180 miles west of the Dakota line. On February 6, 1893, the residents of Glasgow staged an all-night celebration commemorating the event.

Homesteaders came into the county in ever-increasing numbers when the homestead laws were liberalized after 1900, and especially after the Fort Peck Reservation was opened for settlement in 1913, both of which made vast contributions to the growth of the community. Before the influx of outsiders, many of Glasgow's own residents began filing on homesteads. The Glasgow land office was opened in May 1907, and the "News," a paper reporting the limits of the district open for homesteads, listed the area as 12,000,000 acres of land, including the Fort Peck Reservation. The Great Northern Railway in 1909 was busier than ever promoting the agricultural potential of northern Montana.

Thousands of acres of land were plowed and planted to grain in northeastern Montana during the 1920s and 1930s. During this period many of the small dry land farmers went broke, but with improved farming methods, increased acreages and diversified farms the agricultural economy of the area soon became stabilized.

Two important developments that have taken place in Valley County in recent years were the construction of Fort Peck Dam and the Glasgow Air Force Base.

On October 14, 1933, President Franklin D. Roosevelt approved under the Public Works Program, Project #30 which was the construction of Fort Peck Dam. The construction of the dam was

by the Corps of Engineers and at that time was considered to be the largest earth filled dam in the world. This project not only gave work to the people of Valley County, but also gave employment to hundreds of technicians, skilled workmen, and laborers from coast to coast. The peak of this employment occurred on July 15, 1936, when there were 10,546 employees on the Fort Peck Project. Some of the features included in the Fort Peck Dam Project were: the building of a townsite, construction of two railroads, moving of thousands of tons of earth and gravel for the earth-fill dam, construction of a concrete spillway and concrete tunnels, which were later used to generate electricity; and creating a regulated water storage behind the dam for a much needed flood control program.

On August 6, 1934, President Franklin D. Roosevelt made his first visit to Fort Peck, and he again visited the dam on October 3, 1937, to see the close of the dam which would control the migbty Missouri.

The Glasgow Air Force Base began as a fighter unit in 1955. Less than a year after the fighters became operational in 1959, the Air Force ordered SAC to assume command of the base and move a bomber-alert force there as its primary mission. The Glasgow Air Force Base is located 18 miles north of the town of Glasgow in Valley County, northeastern Montana. The base was the home of The Strategic Air Command's 4141st Strategic Wing and the Air Defense Command's 13th Interceptor Squadron. About 400 officers, 2,800 airmen and 300 civilians operate the base and its aircraft, bringing the total military manpower to about 3,500. Almost half the military men have families on the base, bringing the total base population to 7,200. Another 200 military and dependents live within six miles of the base and 1,000 live in Glasgow or surrounding communities.

The value of the Air Force real property on the base is estimated to be about $75 million. Over $10 million in supplies are maintained to support the base, along with almost $10 million worth of support equipment for $158 million worth of Air Defense Command and SAC aircraft. A considerable amount of the Air Base yearly payroll of $25 million is spent by the 3,200 airmen and their 4,500 dependents in Glasgow and the surrounding area of Montana.

Since the Air Base was constructed in 1957, it has provided the town of Glasgow, Valley County and the area of Eastern Montana with a substantial boost in its economy.

It was announced by the Defense Department in 1964 that the Glasgow Air Force Base would be closed on June 30, 1968. Literally hundreds of suggestions have been made on how to use the facilities of the base after its closure. To date nothing definite has been done to establish a use for the $100 million Air Force facility. Without some replacement for this military installation the economy and the population of Valley County will certainly decline.

Today, agriculture is the main source of income for Valley County, with many of the farms diversified. Irrigation farming and livestock raising would constitute the majority of the diversified farms, although dry land farming combined with a livestock operation is carried on to a great extent.

Glasgow, the county seat, is by far the largest town in Valley County and in 1960 had a population of 6,398. Other towns in the county and listed according to their populations are: Nashua 796, Fork Peck 650, Opheim 457, Frazer 425, and Hinsdale 400. Smaller towns and rural communities in the county are: Tampico, Vandalia, Oswego, Richland, Glentana, Lustre, and Larslan. Valley County has a land area of 5,064 sq. miles and a population of 17,080.

CLIMATE

In its Northeastern Montana setting, some 300 miles east of the Continental Divide, most of Valley County is far enough removed from Rocky Mountain eastern slopes so that it may be considered to have a continental type climate, with warm summers, cold winters, wet springs, and relatively light cold season precipitation. The true Rocky Mountain winter "chinook" wind may penetrate as far eastward as Valley County occasionally, but not nearly so often (and for much shorter periods) as in areas farther west. Topography is mostly of a rolling plains or hills type, cut by many coulees as one moves away from the Milk River and Fort Peck Reservoir. Elevations range from near 4,000 ft. MSL on some of the higher hills near the Canadian Border northeast down to about 2,000 ft. MSL where the Missouri River flows eastward near Oswego. With an area just under 5,000 sq. mi., it is a large county with a fairly well-defined annual average temperature gradient between southern and northern boundaries. Drainage systems are complex, with the West Fork of the Poplar River draining much of the hilly northeast corner, Porcupine Creek the central area, and the Milk and Missouri Rivers, fed by many small (and much of the time dry) tributaries, the balance.

In this county, in contrast to more mountainous Western Montana sections, the difference in latitude from south to north appears to be more responsible for climatic variations than topography —although the familiar hill-valley effects on drainage winds, nighttime minimum temperatures, etc., also are factors. The climate element showing the largest latitude effect is temperature, areas along Fort Peck Reservoir, and Milk and Missouri Rivers averaging two to three degrees warmer, on an annual basis, than sections in the northern end of the county. This difference south to north is demonstrable in several ways, but one particularly significant point is the growing season (between 32° occurrences) which runs 124 days at Glasgow (5/19 to 9/20) on the average, but only 99 days at Opheim 12 SSE (5/31 to 9/7). Midsummer afternoon high temperatures average in the middle 80's south to about 80 north, while midwinter low temperatures run from around zero south to 5 below zero along the Canadian Border. This average temperature gradient across the country appears quite consistent from month to month.

Although summers are warm, really hot spells are not common, the number of days with maximums 90 or more averaging from 10 a year north to about 25 south. But record highest temperatures are well over 100° everywhere. Particularly along the river bottoms (Milk and Missouri), appressive summer heat and humidity combinations may occur for a few days in an occasional year, but such spells usually last only a day or two. Winters are normally quite cold, as the data table will show. Several days of subzero cold occur in all years, averaging 41 days a year at Glasgow, and 50 or more along the Saskatchewan Border. This combination of warm summers and cold winters means, of course, that seasonal changes spring and fall are very rapid. May averaging about 30° colder than October.

Although not showing the wide variations common to Montana's mountain counties, precipitation averages vary from about 10 to 14 inches, but without a well-defined pattern except that the hills northeast of Opheim should average a few inches more. Most important here is the fact that from 75 to 85 per cent of the annual average comes during the warm half of the year and the critical month of June averages 3 inches or more over most agricultural sections. Snowfall averages 25 to 35 inches a year—relatively little for a cold climate.

Stormy weather of several kinds is observed in Valley County with some frequency. As in most Montana areas east of the Rocky Mountains thunderstorms during the warmer three months are the most troublesome of all types. From this summer story type come gusty winds, lightning, cloudbursts, and hail, either singly or in any combination. Most years will have some thunderstorms (hail, wind, heavy showers) damage to crops, but—on the other hand—these damage types are seldom widespread. Winter blizzards or cold waves no longer carry the threat they did before modern transportation, heating, communications, etc., were generally available, but they still can be dangerous to the unwary or unprepared. Strong winds beyond those with thunderstorms can and do occur, but not with any unusual frequency. On the basis of fastest mile, it is estimated that Glasgow may have one occurrence of about 70 to 75 mph in 50 years, on the average. Heavy general rains late spring, rapid snow runoff early spring, either singly or in combination, may cause flooding of some seriousness along the Milk River and some of its tributaries—but the frequency is low, on the order of once in 20 to 30 years.

The following table presents data based upon actual observations for periods shown:

TEMPERATURE

Station	Years of Record	Elevation	Highest and Year of Record	Lowest and Year of Record	January Averge	July Average	Average Annual
Fort Peck	1935-1956	2180	108(1936) (1937)	–54(1936)	10.3	72.1	42.5
Glasgow	1911-1955	2090	112(1936)	–59(1936)	9.0	71.9	42.0
Glasgow WBAS	1956-1960	2277	104(1960)	–34(1957)	9.2	72.3	41.9
Hinsdale	1946-1960	2170	107(1949)	–54(1950)	8.1	70.3	41.4
Lustre 4 NNW	1948-1960	2920	103(1949)	–38(1950) (1954)	6.8	68.0	39.5
Opheim	1929-1942	3265	102(1937)	–41(1933)	8.3	68.6	39.3
Opheim 12 SSE	1943-1960	2951	103(1949)	–49(1954)	6.2	64.5	36.4

PRECIPITATION

	Years of Record	Elevation	Yearly Average Total	Growing Season Average Total	Percent Falling in Growing Season	Wettest Year	Driest Year
Baylor	1940-1960	2925	10.98	8.59	78	16.43(1947)	5.79(1958)
Fort Peck	1935-1956	2180	11.02	8.61	78	16.41(1953)	7.03(1949)
Glasgow	1911-1955	2090	13.44	10.15	76	20.85(1938)	6.83(1934)
Glasgow WBAS	1956-1960	2277	8.82	6.64	75	10.39(1957)	7.30(1960)
Glasgow 15 NW	1951-1960	2240	10.05	7.93	79	15.13(1954)	6.42(1958)
Hinsdale	1946-1960	2170	13.23	9.87	75	18.83(1953)	5.16(1958)
Hinsdale 23 N	1951-1960	2400	9.90	7.92	80	13.14(1955)	7.76(1959)
Lustre 4 NNW	1921-1960	2920	11.67	9.52	82	18.66(1948)	4.41(1934)
Opheim	1929-1956	3265	11.86	9.65	81	18.47(1954)	5.07(1931)
Opheim 12 SSE	1943-1960	2951	11.44	9.74	85	16.78(1954)	7.18(1958)

SOILS

Glenn R. Smith, Soil Scientist

The soils of Valley County have been developed over material brought into the district and can be divided according to the soil forming process from the material: (1) glacial soils formed as a result of ice during the glacial period, (2) alluvial soils formed by streams during ancient and recent times, (3) residual soils formed from material weathered from the geological formations.

Local rock formations furnish the material for soils found in a given area. The physiography, drainage, and geologic history influence how these materials were deposited and account for many differences found in soils. Soil depth, texture, and acidity or alkalinity are directly related within limits to the material from which the soil is formed.

The variations in soils result from the alteration of geologic material either in place or transported by climate and living organisms, and especially vegetation. The length of time these forces have been active and the topography is particularly influential in causing visible soil differences over short distances, often within a few feet.

Glacial Soils

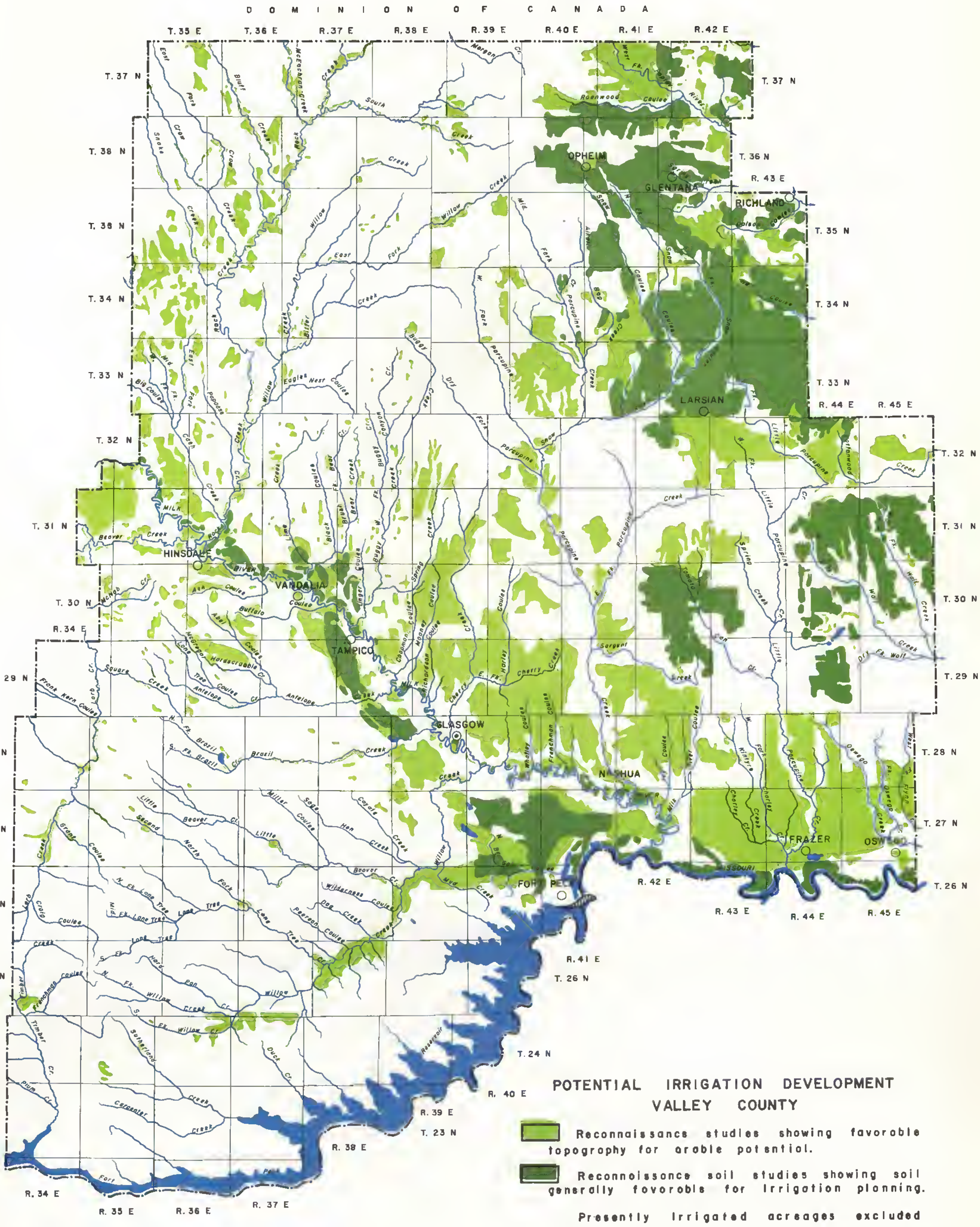
The major event in the geologic history that influenced the soils of Valley County was continental glaciation. Sand, silt, clay, gravel, and boulders were picked up by the ice sheet which mixed them by crushing and then redeposited the mixture known as glacial till, the nature of which is determined by the mixture in the path of the ice sheet. During the retreat of the ice, the running water segregated the material according to particle size. The coarse materials, sand, and gravels, usually settled out near the margins of the ice; the fine materials, silt and clay, settled out further from the ice margins and were often deposited in bodies of still water such as ponds and lakes. Material sorted and deposited by the melt is called glacial outwash.

The glacial soils of Valley County cover a more extensive area than any other type. There are an estimated 719,000 acres which are topographically suitable for consideration of irrigation planning. A reconnaissance survey shows an estimated 242,000 acres of glacial plains and plateaus to have soils warranting such planning. The remaining 477,000 acres need further investigations to determine what areas might be considered for future irrigation planning.

Glacial till was deposited by glaciation into a number of different land forms. The rolling and hummocky topography represents the layers of till covering the upland areas. There are stony ridges and mounds separated by shallow depressions, which were formed at the time the glacial movement was temporarily or permanently halted. The areas that have a concentration of these depressions are known as the prairie pot holes region, which covers a large acreage of Northeastern Montana and neighboring Canada.

Characteristic stream formations also are found in glaciated areas, such as the sinuous ridges which represent the former beds of streams in the glaciers and the gravelly to stony fans (outwashes) where the streams emerged.

The combination of the topography and undesirable till material have formed land areas of either or both soil and topography which are not desirable for irrigation planning. The majority of the


DOMINION OF CANADA
POTENTIAL IRRIGATION DEVELOPMENT
VALLEY COUNTY
Reconnaissance studies showing favorable topography for arable potential.
Reconnaissance soil studies showing soil generally favorable for irrigation planning.
Presently irrigated acreages excluded from survey.
OPHEIM
GLENTANA
RICHLAND
LARSIAN
HINSDALE
VANDALIA
TAMPICO
GLASGOW
NASHUA
FRAZER
OSWEGO
FORT PECK
MILK RIVER
MISSOURI
T. 37 N
T. 36 N
T. 35 N
T. 34 N
T. 33 N
T. 32 N
T. 31 N
T. 30 N
T. 29 N
T. 28 N
T. 27 N
T. 26 N
T. 25 N
T. 24 N
T. 23 N
R. 34 E
R. 35 E
R. 36 E
R. 37 E
R. 38 E
R. 39 E
R. 40 E
R. 41 E
R. 42 E
R. 43 E
R. 44 E
R. 45 E

county is rangeland which grows grasses that are very satisfactory for cattle and sheep grazing. There is also a large acreage which has a medium textured surface soil with a great enough soil depth over the till substratum to produce dryland wheat.

The principal soils are upon a glaciated area with the topography being quite rolling with large boulders and smaller cobble strewn over the surface terrain; local spots of a heavy amount of cobble, gravel, and boulders prevent any cultivation. Large acreages of dryland farming first had to be cleared of these obstructions. The soils are dark grayish brown with three essential layers: (1) the surface layer may range in thickness from 1" to 4" and forms a loose powdery mulch; (2) the silty layer varies from 8" to 15" and is a rich brown color, and this is compact and usually has a well defined columnar structure; (3) below this is a layer of high carbonate accumulation which is underlain by the parent material of a grayish-brown calcareous glacial till. The texture of the glacial till varies but generally it is of a heavy, tight compact nature and restricts drainage to the extent that irrigation would be doubtful. The local name of these soils is the Scobey Series.

There are large acreages of Scobey soils being dryland farmed; a typical example is the glacial plain northeast of Glasgow. The topography of these areas are favorable for irrigation. The limiting factor is poor drainage; the shallow depth to the glacial till substratum, and heavy textured subsoils prevent adequate vertical movement of water to allow the correct salt balance and depth to water table for irrigated crop production. There has been exploratory drilling of deep holes on these glacial plains; the depth to till and the subsoil texture varies, but in general the drainability of the soil is not favorable for a full water supply type of irrigation. A detail soil and drainage investigation may locate certain areas of the Scobey soils which would withstand a sustained irrigated agriculture.

The eastern portion of the county is covered by high gravelly plateaus; an area of 650 square miles was laid down by ancient streams before the time of glaciation. There are approximately 227,000 acres of potential arable land on these high plateaus. An example is the large plateau around Opheim and Richland which slopes to the south and grades into the glaciated uplands at about the 2,600 foot level. The stream deposits are known as Flaxville gravel plateaus; these were probably thinly glaciated to the extent that the higher elevations were above the glaciers. The glacial drift deposits have not modified the character of the soils to any great extent, except about the plateau borders. The plateaus are separated by wide, deep stream depressions of which the main drainages are West Fork of the Poplar River, Roanwood Creek, Cottonwood Creek, Middle Fork Porcupine Creek, Little Porcupine Creek, and the West and Middle Fork of Wolf Creek. The tops of the larger benches are 200 to 500 feet above the glaciated plains. Their surfaces are level and gently rolling, but their borders are in places deeply indented by streams causing the formation of local hills, ridges and buttes.

The general topography of the large area near Opheim is a gently to very gently rolling surface which varies from a 2% to 5% slope. There are large tracts of land scattered throughout the general area that can be irrigated by gravity; however, the majority of the area would be considered for sprinkler type irrigation.

The soils of the plateaus are of the mature Chernozem Group which occupy large portions of eastern Montana, North Dakota and extend into Minnesota. The surface layers have scattered gravel which are rather thick on the surface in spots. A typical profile can be observed at a location 1 mile

south and 3 miles east of Opheim, on the northwest corner of Section 34, Township 36 North, Range 41 East. The soil profile is as follows: 0 - 18" very dark brown, friable loam, crumb structure; 18" - 26" gray brown, firm clay loam, sub angular blocky; 26" - 32" dark gray brown, friable, loam; 32" - 48" light gray brown, sandy clay loam, scattered small gravel; 48" - 60" tan, high lime, firm clay loam, with numerous gravel. The observation of gravel pits showed the approximate depth to the Flaxville gravel to be 15 to 25 feet. The soil variations that exist are: surface textures vary from loam to sandy loam; the high calcareous subsoil varies from near the surface to a 48" depth; the highly calcareous layer varies from firm to cemented, locally known as mortar beds; the texture below the calcareous layer may vary from a firm clay loam to a friable sandy loam.

The present major land use of the high plateaus is dryland wheat farming. The yields of the spring wheat are generally satisfactory but it is not uncommon for drouth to cause a drastic reduction in production. The addition of just one irrigation onto the rainfall moisture would increase the small grain economy of the area. The main limiting factor for any future irrigation is water supply. Ground water yields have not been explored for irrigation; however, available information indicates probable small amounts. The surface water supply is nearly eliminated due to the high elevations of the plateaus above the streams. There may be very small acreages available for irrigation in local areas where groundwater could furnish the water supply.

There are approximately 15,000 acres of potential arable land east of Vandalia between the Milk River and Fort Peck Reservoir. The topography of the glaciated uplands is rolling and of a gently to moderately sloping gradient. The gentle slopes and rolling topography of the ridges will permit sprinkler irrigation; with adequate drop structures and irrigation ditches, gravity irrigation would be possible. The soils are of a clay loam surface texture with a clay loam to silty clay loam subsoil. The salinity is within tolerance of most plants; leaching the soluble salts from the clay loam subsoil is possible within the arable land areas.

The restricting factor for a large acreage of the area is drainage. There are several glaciated small lake basins, and the till substratum is at a shallow depth which prevents adequate downward movement of water.

The water supply for the western portion of the area could be pumped from the Milk River. The eastern portion of the area could receive water from pumping out of Fort Peck Reservoir.

Residual Soils

The depth of the preglacial parent material is shallow throughout the larger portion of Valley County. The glacial material overlying the parent material has eroded until there are large areas of residual soils over Bearpaw shales, Claggett shales and sandstones, and the Judith River sandstones. The soil is heavy to medium textured, high to medium alkali content, and generally of a shallow depth over parent material. The beneficial use of vast areas of residual soil is for cattle and sheep grazing; however, local large benches are suitable for dryland grain crops.

Generally the soils are: silty clay surface mulch one to two inches in thickness; below the mulch is a three to seven inch cubical structured zone; the layer five to nine inches is a stiff, heavy clay, having a high alkaline-saline content, and mottled streaks and brown spots. The subsoil grades into decomposed shales at varying depths. The value of these areas for irrigation planning is generally nil.

The southeastern portion of the county, and other badland areas along the breaks of streams have shallow undeveloped soils overlying the geological formations of the breaks. The large area of Bearpaw and Claggett shale badlands border the Missouri River in the southeastern portion of the County. The shale beds have weathered into dome-shaped hills and ridges, between which are either cut-bank coulees or gently sloping depressions having the character of bad-land basins. The beneficial use of the bad land areas is only for livestock grazing.

Alluvial Soils

These soils occur along streams of Valley County, the largest stream being the Missouri River; however, the second largest stream, the Milk River, is of more agricultural importance. The soils distinguishing characteristics are influenced by their parent material but also to some extent to the degree of development under the agency of the soil forming process. The material below the surface is essentially the same as it was at the time of deposition. Most of the alluvial soils of Valley County are found in the Milk River and Missouri River Valleys, with some being along every stream or drainage throughout the county.

The alluvial soils of Valley County can be divided into two characteristic soil forming processes: first, the most recent alluvial deposits which occur along present streams and drainages; second, the other soil forming process being the alluvial deposits from the preglacial river, the Missouri, with other smaller deposits from many preglacial creeks and drainages. The division of the two soil forming processes cannot be easily distinguished because most of the present streams are flowing in the pre-glacial stream valleys.

In Valley County the Milk River flows in a southeasterly direction in the pre-glacial valley of the Missouri from the Phillips County line to where it empties into the Missouri approximately 6 miles below Fort Peck Dam. The river follows a very meandering course through the valley in the south central part of the county. During low water it is a sluggish stream entrenched from 15 to 3 feet below its flood plain, and it ranges from 60-100 feet in width.

Although in general appearance the valley floor is fairly level, it is very uneven in many places. Recent deposits of alluvium have built up the land bordering the present stream course so that it is actually a few feet higher than some of the land farther away from the stream; many sloughs and old oxbows representing former channels of the river are filled with water at least part of the year. These depressions divide the arable land into very irregular areas which interfere somewhat with its use. Many isolated low glacial mounds and ridges in the valley interrupt the generally level surface relief. The alluvial deposits bordering the Milk River, the depressions, and the glacial mounds and ridges in the valley interfere considerably with irrigation and retard surface drainage during times of high water and the irrigation season.

There are several large acreages of light to medium textured alluvial soils, irrigated agriculture is proving profitable on these soils. Additional drainage facilities are needed in some of the areas to enhance the accrual of agricultural benefits. There are 9,100 acres immediately adjacent to the Milk River that are suitable for irrigation development, but land leveling and clearing of deciduous trees is a prerequisite. The main interfering factor that should be considered in irrigation planning is the general topography of the area adjacent to the river. Many oxbows and sloughs are present; also, the meandering channel of the river interferes with the land forms. The areas of

arable land are therefore small and generally can be considered only for river pump irrigation by individual farmers. The development of canals for service to large areas is not generally possible.

The valley of the Milk River widens out to 3 or 4 miles in width in the vicinity of Rock Creek. Generally the lighter textures soils are recent alluvial deposits adjacent to Rock Creek and the Milk River. As you proceed toward the hills to the north or south of the river, the soils become heavier textured and the clays are of a greater depth. Generally the areas of clay soils that have stratifications of silty clay loams, sandy loams, light clay, and clay loams in the upper four feet are suitable for alfalfa and blue stem hay production; however, these stratifications may be only a few inches in depth and not continuous enough to allow adequate lateral or vertical movement of water. Generally the stratified clays are a transitional zone area between the lighter textured soils adjacent to the river and the heavy textured clays adjacent to the rough slopes of the upland area. The areas bordering the glacial uplands are heavy textured medium clays with a high montmorillonitic clay content, high salinity and alkalinity, and are at a great enough depth to drastically restrict vertical and lateral water movement. The restricted water movement will cause a saline content high enough to prevent production of irrigated crops or hay.

The extreme fine textured soils which tend to predominate in the Milk River and Missouri Valleys can be related to the parent materials. The local names of the heavier textured soils are the Bowdoin clay, Harlem clay, and Orman clay loam series. These soils are formed from various outwash materials of the Bearpaw shale formations that outcrop in the breaks bordering the valley. The clay soils have similar characteristics, and the management for irrigation should be the same. Approximately one-fourth of the irrigated land in the Milk River Valley is on these clay soils. The clays are somewhat similar in physical characteristics, but a number of variations exist in depth and amount of stratifications of lighter textured materials. In places the depth of clay is 48" or more and has no light textured substratum; in other areas sandy substratum may appear in narrow stratifications or as a major texture change above the 48" depth. The use of these soils for irrigation depends upon the depth to the light textured substratum; in general the areas with less than 36" of clay over the light textured material can be utilized by growing western wheatgrass (blue joint) and some alfalfa hay crops. The deeper clay soils are a risk for even blue joint hay production. The surface generally becomes saline and alkali-saline in nature retarding plant growth and eventually causing a non productive area.

The majority of the blue joint meadows are being irrigated by flooding, the water being confined with dikes constructed around the fields. Addition of excessive amounts of water to cover the high spots has necessitated flooding for long periods of time in the spring. Farmers often make no effort to drain the water off the land once the high spots are covered. Under these conditions about one-half ton of low quality hay is produced. Internal as well as surface drainage of these clay soils is poor. Poor surface drainage is due to the low downstream gradient of the valley and the old partially filled in stream channels. The low infiltration rate results from the high clay content of the soil as well as type of clay. The soil cracks between irrigation, and this condition should be considered in irrigating the meadows. The initial water intake rate is high while the water fills the cracks, but when the cracks are closed on swelling, water intake is nil. The correct management as proven by testing should be to slope the land and border dike the meadows with adequate surface runoff drains at the ends of the irrigation runs. When irrigating, apply a large head of water to fill the cracks, and then shut off the water supply which avoids ponding. Fertilization of the meadows with nitrogen have also proven very profitable. The local Federal and State Agricultural Agencies can assist farmers with fertilization and land development practices; a visit with them will prove beneficial.

The larger streams entering the Milk River from the north in Valley County are Rock and Big Porcupine Creeks; and from the south Willow and Larb Creeks, the latter by the way of Beaver Creek.

Rock Creek, formed by the junction of its East and West Forks about 6 miles below the Canadian line, flows in a general southerly direction 7 to 12 miles east of the Phillips-Valley County line and unites with the Milk River in the vicinity of Hinsdale. Below the junction it is a fair-sized stream with sufficient flow during the summer months to allow for limited acreages of irrigation. However, with storage facilities this acreage could be enlarged. There are potential arable lands below the junction of Cash and Rock Creek. The areas adjacent to the creek are light textured alluvial terraces of rather recent deposition. The surface topography is undulating, with small acreages being favorable for pump irrigation from Rock Creek. The land development of these areas will include removal of deciduous trees and land leveling. The soil of the Lower Rock Creek Valley has been previously explained within the Milk River section of this report.

The upper portion of the Rock Creek Valley above Cash Creek is a narrow flood plain bordered by the rolling uplands. The flood plains are quite alkaline and swampy in places; their main use is for livestock grazing.

Big Porcupine Creek and its forks drain the greater portion of the large plateau in the northeastern corner and the area lying below the western slopes of the plateaus in the east-central part of the county. The valley is bordered by breaks extending back a mile or more from the stream. The main forks of Big Porcupine Creek are: Middle Fork; East Fork; and Sargent Creek. There are a few small isolated gravel terraces adjacent to Big Porcupine Creek that may be favorable for irrigation; otherwise, the value of the remaining high alkaline and swampy areas for irrigation is nil.

Larb Creek and its branches drain a small area consisting chiefly of rough broken land. The stream flows north through a preglacial stream course, which may be traced a few miles east of the Phillips County line. The stream course is about 30 miles in length and empties into Beaver Creek about 8 miles west of the latter's junction with the Milk River. The upper portion of the Larb Creek Valley is a broad alkali flat in which the stream is deeply entrenched. The lower portion of the valley is through rolling uplands with colluvial-alluvial slopes into the entrenched stream. There are small acreages of colluvial-alluvial soils on slopes which can be irrigated; however, these areas are too small for consideration in a general plan.

Willow Creek and its tributaries drain a typical badland area, and the alluvial depositions are not favorable for any irrigation.

Antelope and Brazil Creeks are intermittent streams heading in the divide east of Larb Creek. The streams flow east and join the Milk River a few miles west of Glasgow. The upper portions of the flood plains are broad alkali flats which give way lower down to typical glaciated areas. The large area between the potential arable glaciated lands near Tampico and the large potential arable area southeast of Glasgow is the lower flat depression of Antelope and Brazil Creeks which is not considered arable due to seepage, ponding of water and heavy textured clay soils.

The Missouri River Valley below Fort Peck Reservoir is important for irrigation. There are approximately 9,000 acres of river bottom which has not been developed. The soils are similar to the Milk River Valley; with the arable lighter textured soils being on alluvial terraces adjacent

to the river channel. As you proceed north and south of the river, the non-arable heavier textured soils are formed from the high alkaline material which has eroded from the shale breaks; the value of these soils for irrigation is nil.

The Fort Peck Indian Reservation is irrigating most of the favorable soils in the Missouri River valley of Valley County. The development of this project is still progressing. Drainage problems do exist, and drain construction is necessary for maintaining a sustained irrigated agriculture.

The Missouri River drains a relatively small portion of Valley County. The larger tributaries entering the river from the north are Timber, Sutherland, and Little Porcupine Creeks. These streams flow through narrowly entrenched valleys, and the alluvial flood plains are influenced by the parent materials of shale and sandstones. The value of these flood plains for irrigation is nil.

Other streams of Valley County are: Frenchman Creek; Wolf Creek; Morgan Creek; and the West fork of the Poplar River. The flood plains of these streams vary in size from a few feet to I mile and 2 miles in width. The alluvium is generally heavy textured soil of a high alkaline content; also large acreages of seepage are prevalent. The value of the above mentioned stream valleys for irrigation is nil.

In conclusion, the irrigation of alluvial soils in Valley County is generally limited to production of grain and hay for livestock. The average of the estimated irrigated acres harvested show 75% of the land producing hay; 47% producing alfalfa; 21% wild hay and other hay accounting for 7%. The percentage of wild hay production results from irrigation of the slowly permeable soils which generally will not produce adequate yields of any other crop.

Summary

The vast area of Valley County is basically utilized by livestock grazing which is the main adaptable agriculture for this region. Irrigation is a very beneficial means of stabilizing this economy; however, future expansion is limited to the small acreage of favorable soil for an expanded irrigated agriculture. The reconnaissance studies by the Water Resources Survey personnel shows an approximate 735,700 acres being topographically suitable for future irrigation planning; a further study of the soils limits this to only 260,100 acres. Considering the generalities of a reconnaissance study, it is probable that detail studies would increase the potential arable 260,000 acres; however, the general glaciated terrain and soils are not very adaptable to large acreages of irrigable land.

The main problems of irrigation in Valley County is the clay soils. There is a great need for improved water management in the irrigation of these soils. Leaching in agriculture is the process of dissolving and transporting soluble salts by downward movement of water through the soil. Because salts move with water, salinity depends directly on water management, that is, irrigation, leaching, and drainage. These three aspects of water management should be considered collectively in the over-all plan for an irrigated area if maximum efficiency is to be obtained. If we apply this concept to the irrigation of textured soils in Valley County, the first obstacle is drainage; the water must maintain a downward movement to keep the soluble salt content below the toxic limit for the crop grown. The slowly permeable clays that extend below 48 inches and have very few stratifications of lighter soil allow very little vertical movement of water, and many areas will become of a high alkaline-saline content which prohibits even adequate growth of blue joint hay.

The local Federal and State Agricultural Agencies have soil surveys, and experimental information which help in determining areas for future irrigation and management of presently irrigated lands within Valley County. Contacting these Agencies will help individual farmers save money and labor, and also conserve the land for future use.

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CROPS AND LIVESTOCK

Valley County is located in the Northeastern part of the state. It is bounded by the province of Saskatchewan on the north, on the east by Daniels and Roosevelt, on the south by McCone and Garfield, and on the west by Phillips County. The County is bisected almost in the center by the Milk River from the border west of Hinsdale to the Missouri River southeast of Nashua. The natural boundary on the south is the Missouri River. Along these rivers are formed the agricultural valleys in the County.

Approximately over one-half of the County's land area on the west side occupies the four grazing districts, which are the Badlands, Buggy Creek, North Valley, and Willow Creek. The total land area in the districts is 1,775,196 acres with 209 permittees grazing cattle and sheep. Within this area are also public domain, state, title III (resettlement lands), county, and district owned lands.

The Fort Peck Indian Reservation is a part of Valley County which has grazing and agricultural lands.

Valley County contains approximately 3,175,040 acres of land which 74.1 percent is in farms. The economy of the area is largely agricultural. According to the 1964 census, the average size farm in the County is 2,651.4 acres, and 887 farms in number. Valley County cropland acreage is 897,807 acres which includes dry and irrigated land.

The County elevation ranges from 2,100 to about 3,100 feet. The lowest elevations occur in the valleys of the Milk and Missouri Rivers which have their depressions at about the same levels. The

greater part of the County is a rolling plain dissected by rather deep streams and coulees. Aside from rolling plains and benchlands, the more distinctive features are (1) high plateaus, (2) larb hills, and (3) badlands and badland basins in the north central and southern parts of the County.

The climate is influenced by inland continental conditions and is therefore subject to extremes. The frost free season is about 110 to 130 days; this area is subject to winds during the entire year. The precipitation average is 13" to 15" per year.

Dryland cultivated areas produce grains and grain hay while irrigated cropland produces alfalfa hay, permanent pastures and grain. Grazing lands support beef cattle (cow and calf), and sheep (ewe and lamb crop) operations.

From Montana Agricultural Statistics Volume XI, August, 1967
Crop Production—1965 Harvest Acres

Crop	Dryland Acres	Yield Per Acre	Irrigated Acres	Yield Per Acre	Total Acres	Total Value
All Wheat	232,600	22.4	....	.....	....	$6,772,000
All Barley	74,200	34.8	....	.....	....	2,037,300
All Oats	11,100	41.2	....	.....	....	226,500
Flax Seed	600	7.0	....	.....	....	10,400
Alfalfa Hay	5,500	1.6	15,600	2.80	21,100	1,050,000
Wild Hay	7,200	.85	5,600	1.25	12,800	256,000
All Grain Hay	33,700	1.30	....	.....	33,700	898,000
All Alfalfa Seed	300	78.0	....	.....	....	7,600

Livestock on Farms—1966

All Cattle and Calves	Milk Cows	Sheep	Hogs	Chickens
85,300	1,000	21,800	3,300	25,900

STREAM GAGING STATIONS

The U. S. Geological Survey measures the flow of streams, co-operating with funds supplied by several state and federal agencies. The results have been published yearly in book form by drainage basins in Water-Supply Papers through the year 1960. Beginning with 1961, the streamflow records have been published annually by the U. S. Geological Survey for the entire state under the title, "Surface Water Records of Montana". Data for 1961-65 and subsequent five year periods will be published in Water-Supply Papers. Prior to general issuance, advance copies of station records may be obtained from the U. S. Geological Survey. That agency's records and reports have been issued in the preparation of this resume'.

Data given below cover the stream gaging records, which are available for Valley County from the beginning of measurements through the year 1966. The water year begins October 1 and ends September 3 of the following year.

Following are equivalents useful in converting from one unit of measurement to another:

(a) In Montana, one cubic foot per second equals 40 miner's inches.

(b) One acre-foot is the amount of water required to cover an acre one foot deep.

(c) One cubic foot per second will nearly equal two acre-feet (1.983) in 24 hours.

(d) A flow of 100 miner's inches will equal five acre-feet in 24 hours.

(e) One miner's inch flowing continuously for 30 days will cover one acre 1½ feet deep.

For reference purposes, the stream gaging stations are listed in downstream order.

Missouri River below Fort Peck Dam* (McCone County)

The water-stage recorder is about 2 miles upstream from Milk River, 6 miles south of Nashua, and 8 miles downstream from Fort Peck Dam. The drainage area is 57,556 square miles. Records are available from March 1934 to date (1967). The maximum discharge was 51,000 c.f.s. which includes 32,000 c.f.s. inflow from spillway located 1 mile downstream from the station (August 8, 1946) and the minimum, maximum daily reverse flow of 400 c.f.s. caused by backwater from Milk River (March 29, 1943). The average discharge for 5 years (1934-1939, prior to Fort Peck Reservoir reaching operational level) was 6,347 c.f.s. or 4,595,000 acre-feet per year; 23 years (1943-66, after operational level in Fort Peck Reservoir was reached) 9,059 c.f.s. or 6,558,000 acre-feet per year. The highest annual runoff was 10,320,000 acre-feet (1955) and the lowest, 2,642,000 acre-feet (1942). Flow is completely regulated by Fort Peck Reservoir. There are diversions for irrigation of about 876,500 acres above the station.

Beaver Creek near Hinsdale

The wire-weight gage was on highway bridge on old road to Saco, half a mile north of railroad, 4 miles northwest of Hinsdale, and 6 miles upstream from mouth. The drainage area is 1,785 square miles. Records are available from April 1918 to September 1921. The maximum discharge observed was 2,580 c.f.s. (August 23, 1918) and the minimum, no flow at times in most years. Runoff was 84,000 acre-feet (1920) and 38,900 acre-feet (1921). There are numerous diversions above the station.

Rock Creek at international boundary

The water-stage recorder and timber control are three-quarters of a mile south of international boundary, 2 miles upstream from Horse Creek, and 9 miles northeast of Thoeny. The drainage area is 241 square miles. Records are available from May 1914 to October 1915, March 1927 to November 1961 (seasonal records only for most years). The maximum discharge was 3,310 c.f.s. (April 15, 1952) and the minimum, no flow at times in most years. There are several small diversions for irrigation above the station. This was one of a number of stations which were maintained jointly by the United States and Canada.

Horse Creek at international boundary

The water-stage recorder and concrete control are three-quarters of a mile south of the international boundary, 1½ miles upstream from the mouth and 8 miles northeast of Thoeny. The drainage area is 73.5 square miles. Records are available from May 1914 to October 1961 (seasonal records only for most years). The maximum discharge was 1,800 c.f.s. (April 15, 1952) and the minimum no flow for most of each year. There are no reported diversions above the station. This was one of a number of stations which were maintained jointly by the United States and Canada.

Rock Creek below Horse Creek, near international boundary*

The water-stage recorder is 1 mile downstream from Horse Creek, 2 miles south of international boundary, and 21 miles northwest of Opheim. The drainage area is 328 square miles. Records are available from March 1916 to October 1926, September 1956 to date (1967), seasonal records only. The maximum discharge observed was 3,610 c.f.s. (March 31, 1925) and the minimum, no flow at times in most years. The flood of April 15, 1952, reached a discharge of 5,110 c.f.s. There are several small diversions for irrigation above the station. Records for this station are equivalent to the summation of records for Rock Creek and Horse Creek at international boundary. This is one of a number of stations which are maintained jointly by the United States and Canada.

McEachern Creek at international boundary*

The water-stage recorder and concrete control are half a mile downstream from East Fork, half a mile south of international boundary, and 8 miles north of Thoeny. The drainage area is 182 square miles. Records are available from April 1924 to date (1967), seasonal records only available for most years. The maximum discharge was 7,080 c.f.s. (April 15, 1952) and the minimum, no flow at times in each year. There are several small diversions for irrigation above the station. This is one of a number of stations which are maintained jointly by the United States and Canada.

Willow Creek near Hinsdale*

The wire-weight gage is on county road bridge, three-quarters of a mile upstream from Rock Creek and 13 miles northeast of Hinsdale. The drainage area is 283 square miles. Records are available from March 1965 to date (1967). The maximum discharge was 4,040 c.f.s. (May 6, 1965) and the minimum, no flow at times in each year. There is some regulation by numerous small stock ponds on tributary streams. There are no known diversions.

Rock Creek Canal near Hinsdale

The staff gage was located 1 mile downstream from headgates and 5 miles northeast of Hinsdale. Seasonal records are available for July, August 1905, May 1918 to September 1920. The maximum daily discharge was 86 c.f.s. (April 15, 1920) and the minimum, no flow for most of each year.

Rock Creek near Hinsdale

The cantilever and staff gages were 2 miles downstream from Rock Creek Canal diversion and 5 miles northeast of Hinsdale. The drainage area is 1,313 square miles. Records are available from April 1906 to September 1907, May 1912 to September 1920 (no winter records most years). The maximum discharge observed was 6,220 c.f.s. (June 8, 1906) and the minimum, no flow at times in most years. The entire flow is diverted for irrigation, at times.

Milk River at Hinsdale

The chain gage was at old county road bridge, three-quarters of a mile northeast of Hinsdale. The drainage area is 20,897 square miles. Records are available from May 1908 to November 1914 (no winter records most years). The maximum discharge was 24,200 c.f.s. (April 6, 1912) and the minimum, no flow (August 9-13, 1910). There are many diversions for irrigation upstream from station.

Milk River near Vandalia

The staff gage was at Vandalia Dam 3 miles northwest of Vandalia. The drainage area is 20,926 square miles. Records are available from October 1914 to September 1925, August 1928 to September 1939. The maximum discharge observed was 27,200 c.f.s. (April 1, 1925) and the minimum, no flow at times. The average discharge for 22 years (1914-25, 1928-39) was 755 c.f.s. or 546,600 acre-feet per year. The highest annual runoff was 1,220,000 acre-feet (1917) and the lowest, 52,600 acre-feet (1931). There are many large diversions for irrigation above the station. Since 1917, flow has been increased during irrigation season by discharge of St. Mary Canal.

Lime Creek near Tampico*

The water-stage recorder is 100 feet downstream from bridge on U. S. Highway 2, 4 miles upstream from mouth, and 4 miles northeast of Tampico. The drainage area is 105 square miles. Records are available from October 1957 to date (1967). The maximum discharge was 2,200 c.f.s. (May 6, 1965, but may have been higher June 6 or July 11, 1963) and the minimum, no flow for most of each year. The average discharge for 9 years (1957-66) was 4.69 c.f.s. or 3,400 acre-feet per year. The highest annual runoff was 7,720 acre-feet (1960) and the lowest, no flow (1961). There is some storage in stock ponds upstream from the station.

Willow Creek near Glasgow*

The water-stage recorder is 6 miles south of Glasgow and 8 miles upstream from the mouth. The drainage area is 538 square miles. Records are available from October 1953 to date (1967). The maximum discharge was 12,400 c.f.s. (July 14, 1962), and the minimum, no flow at times in each year. The average discharge for 13 years (1953-66) was 56.5 c.f.s. or 40,900 acre-feet per year. The highest annual runoff was 104,800 acre-feet (1962) and the lowest, 938 acre-feet (1958). There are now more than 270 storage and detention reservoirs upstream. Water spreader irrigation of about 5,000 acres of hay or pasture lands to extent of available flow.

Milk River at Nashua*

The water-stage recorder is at former highway bridge site, 0.6 miles southwest of Nashua, and 5 miles upstream from Porcupine Creek. The drainage area is 22,332 square miles. Records are available from October 1939 to date (1967). The maximum discharge was 45,300 c.f.s. (April 18, 1952) and the minimum, 0.6 c.f.s. (July 15, 1961). The average discharge for 27 years (1939-66) was 688 c.f.s. or 498,100 acre-feet per year. The highest annual runoff was 1,713,000 acre-feet (1952) and the lowest, 67,450 acre-feet (1961). Flow regulated by Fresno and Nelson Reservoirs and four res-

ervoirs in Frenchman River basin in Saskatchewan. Diversions for irrigation of about 140,000 acres upstream from station. Since 1917, flow has been increased during irrigation season by discharge of St. Mary Canal. (Records of chemical analyses and water temperatures are available for some years.)

Porcupine Creek at Nashua

The staff gage was a quarter of a mile upstream from highway bridge and three-eighths of a mile north of Nashua. The drainage area is 725 square miles. Records are available from August 1908 to October 1924 (no winter records some years). The maximum discharge was 2,700 c.f.s. (April 11, 1916) and the minimum, no flow at times. The flood of March 24, 1930, computed as 35,500 c.f.s. by U. S. Indian Service, was caused by failure of Middle Fork dam. The average discharge for 8 years (1909-11, 1913-14, 1916-21) was 21.9 c.f.s. or 15,850 acre-feet per year. The highest annual runoff was 28,200 acre-feet (1917) and the lowest, 6,720 acre-feet (1911). Flow partly regulated since 1918 by reservoir on Middle Fork Porcupine Creek.

Little Porcupine Creek at Frazer

The staff gage was half a mile upstream from diversions dam and half a mile north of Frazer. The drainage area is 280 square miles. Records are available from July to December 1908 (gage heights and discharge measurements only), January 1909, September 1916, April to July 1918, September 1919 (no winter records most years). The maximum discharge observed was 750 c.f.s. (April 1, 1916) and the minimum, no flow for many days each year. The annual runoff was 6,630 acre-feet in 1910 and 2,040 acre-feet in 1914. There are no diversions above the station.

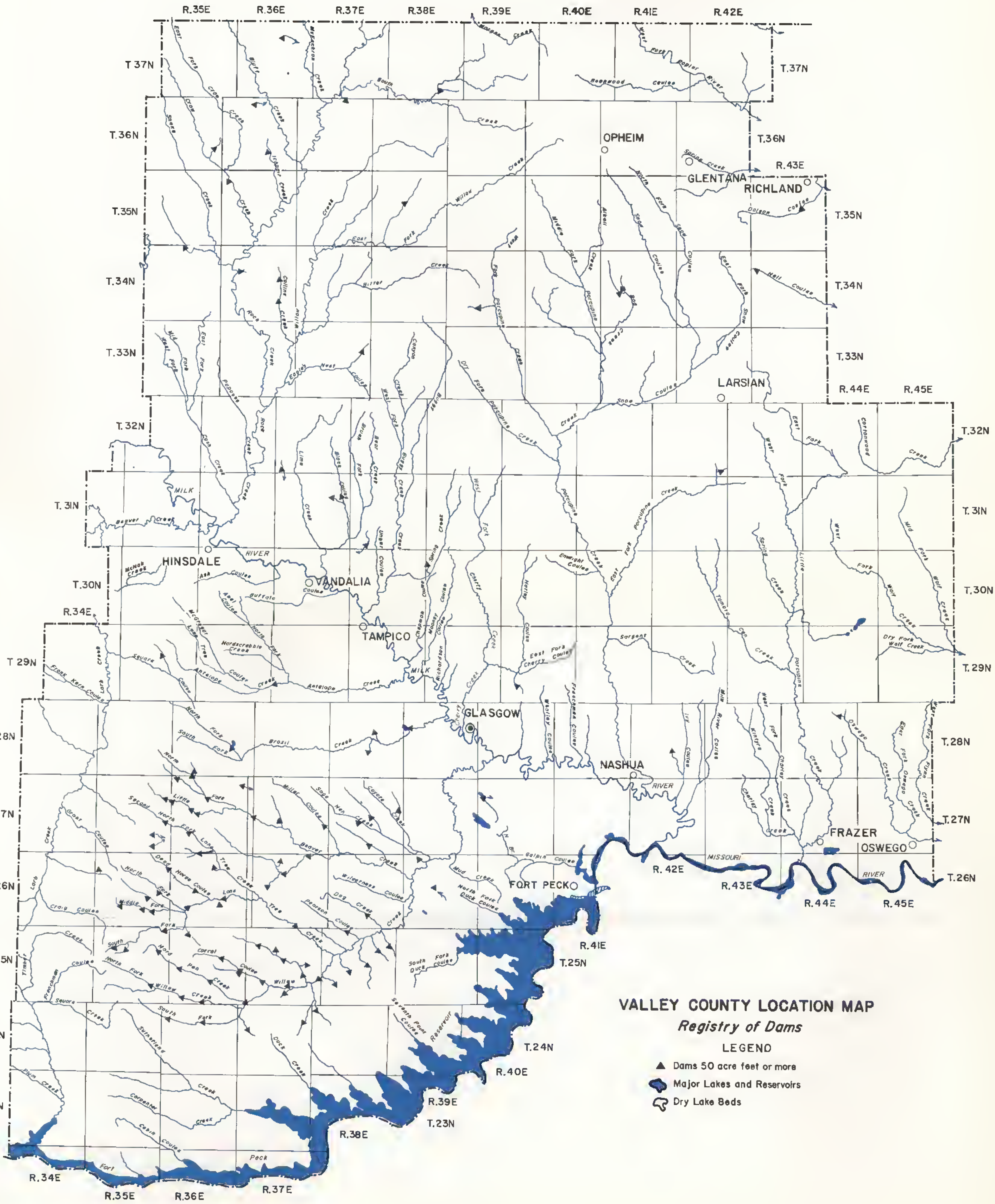
West Poplar River at international boundary

The water-stage recorder was at West Poplar Canadian Customs Post, 100 feet north of international boundary, 8 miles upstream from Roanwood Coulee, and 10 miles north of Opheim. The drainage area is 139 square miles. Records are available from March 1931 to October 1952 (no winter records except water years 1936-37). The maximum discharge was 5,450 c.f.s. (April 14, 1952) and the minimum, no flow at times in each year. The annual runoff was 1,650 acre-feet in 1936 and 196 acre-feet in 1937. No known diversions or regulation above the station. This was one of a number of stations which were maintained jointly by Canada and the United States.

Partial record stations and miscellaneous discharge measurements

In order to provide information on more streams than are covered by stream gaging stations, the U. S. Geological Survey has for several years been collecting some partial records. These are in addition to the miscellaneous discharge measurements which have always been reported. These partial records, when correlated with simultaneous discharges of nearby continuous-record stations give fair indications of available flow.

There are four crest-stage partial-record stations in the Milk River Basin in Valley County. Stations are now (1967) being operated on Unger Creek near Vandalia, Mooney Coulee near Tampico, Milk River Tributary No. 2 near Glasgow, and West Fork Wolf Creek near Lustre.



VALLEY COUNTY LOCATION MAP
Registry of Dams
LEGEND
Dams 50 acre feet or more
Major Lakes and Reservoirs
Dry Lake Beds
R.35E
R.36E
R.37E
R.38E
R.39E
R.40E
R.41E
R.42E
R.43E
R.44E
R.45E
R.34E
T.37N
T.36N
T.35N
T.34N
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T.24N
T.23N
OPHEIM
GLENTANA
RICHLAND
LARSIAN
HINSDALE
VANDALIA
TAMPICO
GLASGOW
NASHUA
FRAZER
OSWEGO
FORT PECK
MILK
RIVER
MISSOURI
Fort
Peck
Reservoir

The partial-record stations as well as the miscellaneous discharge measurements are listed at the end of each U. S. Geological Survey Water-Supply Paper of Surface Water Records report.

Reservoirs

Details of operation records for the following reservoirs are available in U. S. Geological Survey publications:

Fort Peck Reservoir at Fort Peck*

The water-stage recorder is located in the No. 4 emergency gate shaft of Fort Peck Dam, 2 miles downstream from Bear Creek, 9½ miles southwest of Nashua and about 9½ miles upstream from Milk River. The drainage area is 57,500 square miles. Records are available from October 1937 to date (1967). The maximum contents was 18,140,000 acre-feet (July 22, 1965) and the minimum since first filling, 5,061,000 acre-feet (January 25, 26, 1956). Storage began in 1937. The total capacity is 19,140,000 acre-feet below elevation 2,250 feet (top of 25 foot gates). Normal maximum operating level is 18,170,000 acre-feet (elevation 2,246 feet). Minimum operating level for on-site power generation is 4,346,000 acre-feet (elevation 2,160 feet). Dead storage is 563,900 acre-feet below elevation 2,095 feet. Water is used for navigation, recreation, flood control, and power generation.

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*This station is now in operation (1967).

DAMS AND RESERVOIRS

The State of Montana has no statutes governing the design or construction of dams and, except for projects which the Montana Water Resources Board has constructed, the Board has no means of automatically obtaining information concerning design specifications, storage capacities, locations, or ownership of dams and reservoirs built throughout the State. Consequently, steps have been taken to make this information available for use by the State, the Federal Government, and private citizens.

By means of a questionnaire, the Montana Water Resources Board recently obtained from the various federal agencies who design structures, the basic engineering data, locations, and ownerships of dams and reservoirs for which they either have, or had, responsibility and which have storage capacities of 50 acre-feet or more. The contributing federal agencies were the Soil Conservation Service, the Forest Service, the Bureau of Reclamation, and the Bureau of Land Management. The Montana Power Company also participated in the study.

Information on numerous dams and reservoirs constructed by private individuals in Montana is not available and is, therefore, omitted. However, the Board's Water Resources Survey crew, while working in Valley County, obtained information on private dams and reservoirs within this county. The available information obtained from all sources was compiled by the Board for each county in the State and a list of dams and reservoirs which store 50 acre-feet or more of water was published.

GROUNDWATER

A. J. Mancini, Geologist

Summary*

Ground-water possibilities in Valley County are directly related to the geological occurrence of suitable aquifers (materials or rocks that yield usable quantities of potable water). Such aquifers, from most recent to older rocks, are as follows:

Alluvium.—Gravel, sand, and silt of the Milk and Missouri River Valleys and some of the tributaries where streams have deposited sufficient thickness of loose materials. Quality of water from such sources is classified as fair to good.

An older preglacial alluvium may be found at greater depth in parts of the Milk River Valley; it represents deposits of the preglacial Missouri River.

Glacial outwash.—Most of the land in Valley County is covered with glacial drift, which is a poor aquifer capable of yielding only small quantities of water containing sodium sulfate. Outwash channels (glacial stream channels) may be encountered, and because such channels are formed of alluvium, they may yield more ground water than the drift.

Flaxville Gravel.—The older preglacial gravels are capable of yielding adequate supplies of relatively good water. The thickness and extent of the gravel deposit determine the amount of water that may be withdrawn. Recharge is restricted by the overlaying glacial debris, and continuous large-volume use from numerous wells is not advisable.

Hell Creek-Fox Hills Sandstone strata.—Sandstone beds in the Hell Creek Formation and the Fox Hills Sandstone will yield small to moderate amounts of good water, depending on recharge and the geological situation.

Judith River Formation.—The Judith River strata include sandstone beds capable of yielding water, but its quality is fairly poor. In areas where these beds are overlain by the Bearpaw Shale, wells drilled through the Bearpaw encounter artesian pressure, and pumping from the Judith River may be feasible.

The records of the Montana Bureau of Mines and Geology show that 1,176 water-well appropriation forms were filed as of December 31, 1966. Of these, 429 are listed as stock wells, 397 as stock and domestic, 260 as domestic, 32 as public supply, 21 as irrigation, 8 as commercial, and the rest as miscellaneous.

Although these figures indicate extensive use of the ground water, the resource is not strained. Technological advances in economical means of improving water quality will insure a much greater use in the future.

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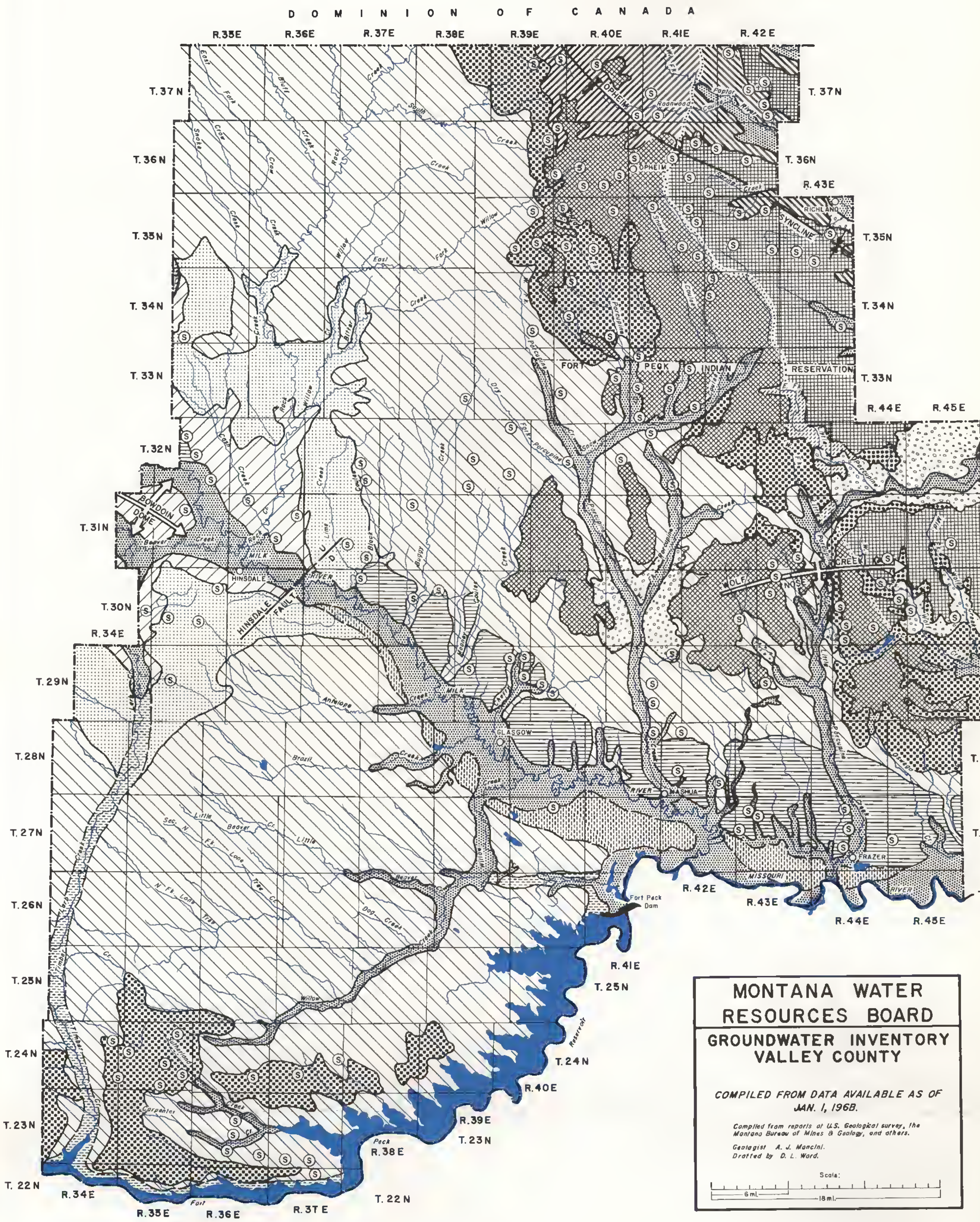
*Contributed by the Montana Bureau of Mines and Geology



EXPLANATION

- Flood Plain--alluvium may yield small amounts of water from flood plain, moderate to large amounts from buried valley fill.
- Buried Pre-glacial Missouri River Valley--Moderate to large yields form valley fill.
- Pre-glacial Drainage Channel--fair to moderate yields possible locally.
- Abandoned Temporary Drainage Channel--unknown potential at present.
- Areas formerly covered by glacial lakes, deposits of fine sand, silt, and clay with erratics--no known potential.
- Fluvial Terraces:
  - Remnants of Gravel-capped Terraces, mantled with glacial deposits--unreported potential.
  - Flaxville Gravels, Glaciated (G)/Unglaciated (U)--undetermined potential, fair to good quality water.
- Fort Union Formation Bedrock, Glaciated (G)/Unglaciated (U)--small yields from shallow depths, fair to good quality water.
- Hell Creek-Fox Hills Sandstone Bedrock, Glaciated (G)/Unglaciated (U)--small yields from shallow depths, fair to good quality water.
- Bearpaw Shale Bedrock mantled with glacial deposits--small yields locally from glacial deposits.
- Judith River Formation Bedrock, Glaciated--small yields from bedrock and glacial deposits, mineralized water in Judith River sandstones.
- Claggett Shale Bedrock mantled with glacial deposits--small yields possible locally from glacial deposits.
- (S) Reported Spring.
- Structural dome or nose.
- Structural syncline.
- U/D Fault.

GEOLOGY

The availibility of groundwater in Valley County is directly related to geologic events which took place long before Man was known to exist. Many millions of years ago layers of sand and gravel were deposited in a rudimentary drainage system considerably different from the one now active. These deposits are now the buried valley-fill aquifers from which much of the available groundwater is being withdrawn. Other river gravels were spread over a rolling plain and contain aquifers within a widespread blanket of stones resting on bedrock. Groundwater is available in bedrock aquifers because structural uplift and erosion millions of years ago brought these aquifers closer to the surface, and permitted once-buried sedimentary formations to become exposed to the atmosphere. The same natural forces which brought about useful artesian pressures were also instrumental in causing climatic changes that culminated in the advance of ice sheets hundreds and perhaps thousands of feet thick from Canada southward and westward into Valley County.

The "Ice Age," as the time of this ice invasion has been called, began about 1,000,000 years ago. Glaciers advanced and retreated periodically, with the final retreat about 40,000 years ago. Interglacial ages of milder weather predominated during ice-retreats. The present time may be an interglacial age, inasmuch as a polar ice-cap does still exist and can either expand or shrink in centuries to come. Much of the county has a mantle of glacial till remaining as testimony to the movement of ice through the area.

Advancing ice caused a permanent diversion of the Missouri River from its preglacial valley, and pushed the river bodily out of its channel ahead of southward moving glaciers. The Missouri River eventually occupied a trough 50 miles farther south. The Missouri River below the town of Nashua has remained in its preglacial channel, while the evacuated preglacial upper portion of the Missouri channel is now occupied by the Milk River. Other preglacial streams were also displaced, and buried valleys are known to be present under the Milk River flood plain and elsewhere. Major drainage changes have occurred but the topography of Valley County is thought to be generally the same now as it was during the most recent glacial ice-melt.

The availability of groundwater is affected by the preglacial structural deformation of the earth's crust, as well as the aforementioned glacier advance, changes in drainage patterns, and topography. The pattern of the outcropping bedrock, exposed or covered by glacial till, is a reflection of the deformation. Regional structural features in Valley County are the east plunge of the Bowdoin dome, and the Opheim syncline. The Bowdoin dome uplift in the west-central part of the county is evident from the outcrop patterns of the Claggett and Judith River formations. The significance of the dome is apparent in that Judith River aquifers are closer to the surface or have been completely removed. In the northeastern part of the county the downwarp of the Opheim syncline hosts aquifers not present elsewhere in the county. The amount of structural relief from Bowdoin dome to the Opheim syncline is about 1,400 feet, or approximately 30 feet per mile in a northeasterly direction. Geologic structure is a major influence on the movement of underground water.

AQUIFERS

An important source of potable groundwater is the buried valley fill under the Milk River flood plain. Other sources are the blanket-gravels of the Flaxville plain and sandstones of the bedrock formations. The aquifers are described individually in sequence of geologic age, the youngest or

most shallow first and the deepest last. Water-well data have been taken from State records of the Groundwater Code Administrator, the Oil and Gas Conservation Commission, and the Department of Health.

Alluvium (Quaternary)—is a recent geologic accumulation of fresh-water sand, silt, gravel, and clay, mixed and interbedded and normally unconsolidated or only weakly cemented. In Valley County, floodplain deposits of the Milk and Missouri Rivers and of the larger tributaries comprise the alluvium. The surficial floodplain deposits contain some local aquifers but generally are not good water suppliers due to a high clay content, which causes imperviousness and poor percolation. Alluvium in the upper reaches of the tributaries is more prospective as a source of groundwater than floodplain alluvium. Similarly, colluvium of the high benches and upper slopes is a potential aquifer but of unknown groundwater potential.

Glacial Deposits (Quaternary)—are inferred to have covered much of Valley County at one time but have since been stripped from major valleys and some hilly areas by post-glacial erosion. This material is glacial till, for the most part an unstratified mixture of dense gray calcareous clay with boulders of quartzite, limestone, and granite, and seldom an aquifer due to low porosity and permeability. About 20% of the volume of the till is estimated to be sand, gravel, and stones which provide storage space locally in outwash deposits for a small amount of the available potable well-water in the county.

A large amount of water is available through wells from buried valley fill, a heterogeneous accumulation of glaciofluvial clastic material which collected in valleys and depressions during the glacial epoch. Within the fill, at depths approaching 200 feet under the surface, are aquifers of gravel and sand. The aquifers are of varying thicknesses, of unknown extent, and therefore cannot be judged as capable of large sustained yields. Wells which penetrate at least 20 feet of saturated clean gravel at the base of the fill have the best yields. Buried valley fill is interpreted to be present under the Milk and Missouri Rivers' flood plains and locally in narrow preglacial or temporary drainage channels elsewhere in the county.

Terrace Gravels (Quaternary-Tertiary)—are found mantled with glacial till, part of a dissected benchland on the north side of the Milk River and on the north side of the Missouri River downstream from the town of Nashua. Terrace gravels are found at several levels within the benches and were derived in part from material of the Flaxville plain north of the river in the eastern portion of Valley County. A large part of Valley County reportedly has a buried preglacial mantle of gravel ("Wiota gravels") over bedrock, and at the base of buried stream channels. Most exposures of the Wiota are high on valley sides, suggesting original deposition as older stream terraces. Extensive exposures border the valleys of the Milk River and larger tributaries. The maximum thickness of the Wiota is reported as about 50 feet. The Wiota gravels are a shallow source of groundwater and the quality reportedly is good.

Flaxville Gravel (Tertiary)—is found on the Flaxville plain, a large area of eastern Valley County which was dissected by streams prior to the glacial epoch. The gravel rests on an eroded preglacial topographic surface. The varying thickness of the Flaxville gravel—from a few feet to a hundred feet—is due to the underlying topographic relief. The "gravel" is a composite of clay, sand, and gravel with large stones, which was spread by eastward flowing streams some 10- to 25-million years ago. Locally the gravel has been cemented into conglomerate by calcium carbonate. In places the

gravel is overlain by glacial till and at least one accumulation of wind-blown dune sand has been reported covering gravel on the Flaxville plain. Large areas of the plain are free from glacial till indicating that the advancing ice sheets were separated by high topographic mounds in the eastern part of the county, or that erosion has removed the till from certain areas. The basal portion of the gravel deposit is normally about ten feet thick but sometimes as thick as 30 feet, and is water-saturated and utilized as a source of good well-water from less than 20 to more than 100 feet deep. The maximum reported well-yield from the gravel is 100 gpm (gallons per minute) while 10 gpm is most commonly reported.

Fort Union Formation (Tertiary)—is a sequence of relatively soft light-colored sandstones, siltstones, and shales, with a few coal seams. Rocks of this sequence are the youngest bedrock strata and are found only in the structurally lowest part of the county. An adequate water supply reportedly is available from wells 70 to several hundred feet deep, and flowing wells may occur locally from greater depths in topographically low areas. The water generally is relatively low in amount of total dissolved solids but may have a high sodium content. Well-yields are 5 to 30 gpm.

Hell Creek-Fox Hills (Cretaceous)—is a sequence of brown sandstones and shales in the northeastern and southwestern parts of the county. The interval has an eroded thickness of less than 100 feet presumably to as much as 600 feet thick under the Fort Union formation. Water is pumped through wells 75-350 feet deep, at rates of 5 to 30 gpm.

Bearpaw Shale (Cretaceous)—is an interval of blue-black shale of varying thickness due to erosion, as much as 1,000+ feet thick under younger bedrock, and not normally an aquifer.

Judith River Formation (Cretaceous)—is a gray-tan interval of sandstones, shales, and clays, with a few coal seams, found everywhere in the county at some depth, excepting over the crest of Bowdoin dome. A complete thickness is about 500 feet. The better aquifers are in the basal part of the formation. Water-bearing sandstone layers of 2, 30, 60, and 100+ feet in thickness have been reported, and several of these layers may be present at one well site. The maximum gross thickness reported for a basal sandstone aquifer is 225 feet, beginning about 270 feet below the top of the formation. The gross interval was reported to be "clean wet sand," and all but 12 feet were covered by pipe perforations. The depth to the top of the first Judith River aquifer varies from about 50 to 800 feet, with depth to aquifer usually in the range 100 to 500 feet. Although the sandstones are artesian aquifers, a well normally has to be drilled to a total depth of 300 to 700 feet in order to use the water and deeper wells are not uncommon. In the outcropping bedrock (under an uneven cover of glacial till), the shallowest sandstones are dry but water is found at a depth of about 200 feet below the surface. Normal yields from the Judith River are commonly in the range of 5 to 40 gpm. Numerous wells report flowing yields.

Claggett Shale (Cretaceous)—is an interval of shale similar to the Bearpaw shale and not normally an aquifer. The reported thickness of this formation varies from 300 to 600 feet.

Eagle Formation (Cretaceous)—is about 250 feet thick and consists of siltstone and shale unfavorable for groundwater development in Valley County.

Colorado Shale (Cretaceous)—is more than 1,000 feet thick of dark-colored shale with standstone lenses and stringers, none of which is considered an aquifer. The natural gas of Bowdoin field occurs in silty sandstone lenses in this interval, at depths approaching 1,000 feet below the surface.

Kootenai Formation (Cretaceous)—is part of the Dakota-Lakota sequence which is 300 to 400 feet of sandstones and shales containing some of the best artesian aquifers in Central Montana. There are no reported wells in the county presently using Kootenai water, probably due to depth to aquifer which varies from 2,500 to 4,000+ feet.

Ellis Interval (Jurassic)—is a group of limestones, sandstones, shales, and evaporites which attain a collective thickness of about 450 feet. Local potential aquifers may be present.

Big Snowy Group (Mississippian)—is an interval of sandstone, limestone, and shale in the extreme eastern part of the county, thickening from a wedge-edge to 200 feet and locally containing a potential aquifer. Depth to aquifer is greater than 5,000 feet and deters present development of this groundwater source.

Madison Limestone (Mississippian)—attains a thickness in excess of 1,000 feet, thickening from west to east. The sequence of light-colored limestones, sometimes having cavernous porosity in an upper massive unit, has been penetrated by deep exploratory wells and is capped by an eastward-thickening wedge of shales, carbonates, and evaporites in a portion of the county. The light-colored limestones carry "fresh," brackish, and sulfur water, the quality generally deteriorating in an eastward direction. The uppermost evaporitic sequence, where present, could be expected to carry brackish to saline water and brine.

Pre-Mississippian Aquifers—are present below the Madison in the 2,700+ feet of Devonian, Siluro-Ordovician and Cambrian sediments. These rocks have not been explored as sources of water due to the availability of potable water in shallow aquifers.

Pre-Cambrian—rocks could be water-bearing in fractures or formational contacts but normally are not considered aquifers.

GROUNDWATER AREAS

Valley County can be apportioned geographically into several groundwater areas, some of which can be further subdivided on the basis of morphology: (1) the floodplain of the Milk River and tributaries, (2) the floodplain of the Missouri River and tributaries, (3) fluvial terraces, (4) the Flaxville plain, (5) the northern Bowdoin plain, and (6) the southern Bowdoin plain.

The Floodplain of the Milk River and Tributaries. The recent alluvium of the floodplain contains a high content of impervious clay and is not a reliable source of groundwater. Numerous wells penetrate the floodplain deposits and reach the underlying buried valley fill of the preglacial Missouri River, which includes gravels and coarse sands that are good aquifers. The buried valley fill is the source of the best water, in terms of quantity, in the county. Depth to aquifer in the valley fill varies from about 45 feet to almost 200 feet. The water-bearing units are sands and sandy gravels, lensatic in distribution and varying in thickness from five to 20+ feet. Numerous wells are completed in the upper few feet of these aquifers and do not obtain the benefits of full aquifer penetration. Reported well yields commonly are in the range of 10 to 20 gpm. The city of Glasgow uses three municipal wells, each rated at 1,000 gpm from depths of 108, 112, 121 feet. The aquifer in each of these three wells is described as coarse gravel with an effective thickness of about 17 feet. The town of Nashua has at least one municipal well 51 feet deep rated at 70 to 700 gpm, pumping from a sand and gravel aquifer logged at 21-50 feet.

A portion of the floodplain is on the eroded crest of Bowdoin dome in Tps. 31 and 32 N., Rgs. 34 through 36E. The water wells located here pump 10 to 20+ gpm from sand and gravel at depths of 40 to 170 feet. A part of the Bowdoin gas field extends across this same area, and utmost caution should be observed by anyone drilling wells here due to the inherent hazards associated with the presence of shallow flammable gas. The approximate southeast limit of the gas field is marked by the bedrock trace of the Hinsdale fault, trending northeast-southwest across the Milk River in T. 30N. as shown on the accompanying map.

Along some of the tributary creeks the recent alluvium is of sufficient thickness to contain sand and gravel aquifers, and a few wells have small pumping yields from depths less than 25 feet below the surface.

Most of the Judith River bedrock water wells are located in the valleys of the Milk River and tributaries. The combined effects of structural uplift of Bowdoin dome and low topography of the valleys bring Judith River aquifers closer to the surface. Depth to aquifer varies from less than 100 feet near the town of Hinsdale (structurally updip) to about 300 feet in the vicinity of Glasgow (downdip), and about 600 feet near the town of Nashua (further downdip). Judith River sandstones are artesian aquifers and some of the wells flow up to 20 gpm. Pumping yields are reported up to 40 gpm.

The Floodplain of the Missouri River and Tributaries. A small number of wells in the valleys of the Missouri River and tributaries pump water from sand and gravel aquifers 10 to 110 feet below the surface. Even wells with the thickest saturated aquifers (about 25 feet) report yields in the range of only 10 to 25 gpm with drawdowns of about 10 feet. The few Judith River water wells located here have total depths of 640 to 940 feet below the surface. Flowing yields of 4 to 10 gpm are the rule for these wells.

Several water wells in T. 27N., Rgs. 40 and 41E. pump from sands and gravels approximately 150 feet below ground level, apparently in buried fill of preglacial drainage channels. One well in Section 19, T. 27N., R. 41E., at a total depth of 152 feet, reportedly yields 400 gpm with a pumping water level of 60 feet and a saturated aquifer thickness of 12 feet. These aquifers are erratic in distribution and probably would not support large sustained yields.

Fluvial Terraces. At least one ancient dissected river terrace is interpreted to be present under a mantle of glacial till, on the north side of the preglacial Missouri River. Exposed in the terrace slopes are several intervals of water-bearing gravels which probably were derived from weathering of older gravel deposits to the north. These aquifers are 6 to 50 feet thick according to reports and are local sources of water at depths to 150 feet. Springs are common, apparently issuing from gravel beds at various levels within the terrace heights, along the slopes of valleys and coulees. The reported range of flow is 10 to 50 gpm, with several relatively large flows of 500 gpm. Springs are developed for domestic, stock, and limited irrigation uses.

Flaxville Plain. Several hundred feet above the major drainage valleys is the stream-cut remnant of a broad, rolling plain covered by the Flaxville gravels. Most of the plain is unglaciated but a portion is mantled with glacial till. The gravel deposit has a gross thickness of about 100 feet but not all of this thickness is water-saturated. The thickest reported gravel interval is 135 feet, including in the basal part what might be broken sandstone bedrock. Water wells have been completed

in this formation at depths of 15 to 140 feet, yielding 10 to 100 gpm. Most of the wells have not penetrated the complete gravel thickness and the potential of the Flaxville aquifer is probably much greater than indicated by the present stage of development.

Other aquifers are found in bedrock sandstones of the Fort Union formation and the Hell Creek-Fox Hills sequence. Due to the effects of erosion these bedrock aquifers are locally found at relatively shallow depths. The Fort Union thus is the shallowest bedrock formation in T. 37N., from where it passes under the Flaxville gravel in the southeastwardly direction. Numerous wells pump 5 to 30 gpm from sandstone aquifers at depths of 50 to 170 feet below the surface. The two deepest Fort Union wells reported are 230 to 330 feet deep, and water is present in the Fort Union formation at even greater depths.

Additional aquifers are found in the Hell Creek-Fox Hills sequence. The bedrock pattern of this sequence delineates the western limb of the Opheim syncline. In an eastward direction this sequence passes under the Flaxville gravel or the Fort Union formation, depending upon the local configuration of the Opheim syncline. Where erosion has removed the bedrock or gravel overburden, the Hell Creek-Fox Hills may have a spotty cover of glacial till or a sprinkling of drift. Water is obtained from sandstone aquifers in the Hell Creek-Fox Hills interval at depths of 75 to 400 feet below the surface, and is present within this interval at even greater depths. Reported well yields are small, in the range of 5 to 15 gpm, and up to 30 gpm from one of the deeper wells.

Numerous springs are effectively utilized on the Flaxville plain. Spring water is available from the Flaxville gravels, the Fort Union formation, and the Hell Creek-Fox Hills sandstones. The springs are located in valleys and stream-cuts where the combined effects of surface topography and subsurface structure cause the basinward percolation of groundwater to be intercepted and released at the surface.

Northern Bowdoin Plain. The Northern Bowdoin plain is that part of the county north of the Milk River and west of the Flaxville plain and is surfaced with glacial till. The shallowest bedrock in much of this area is impervious Bearpaw shale. A smaller area of Judith River outcrop encloses a window of Claggett shale near the center of the western county boundary. Relatively few water wells have been drilled in the northern Bearpaw plain, and these in areas of shallow Judith River aquifers or sands and gravels in tributary valleys. Reported well yields are small. A thick overburden of Bearpaw shale implies that a well must be drilled about 1,500 feet in order to reach the better Judith River aquifers. In such an instance deposits of glacial outwash gravels could be important sources of potable water. Claggett shale bedrock at the surface implies drilling wells deeper than 2,500 feet to reach reliable sources of potable water.

The few springs in this area apparently issue from Judith River sandstones where erosion in valleys and coulees has caused the interruption of underground flow. There are several appropriations of water from springs located in valleys cut in Bearpaw shale; these springs may be due to gravity drainage from outwash gravels or buried valley fill resupplied by surface runoff. Some of the springs in the area of supposedly thick Bearpaw shale are on alignment with the trace of the Hinsdale fault. The source of water supplying these springs may be related to fracturing in the deeper Judith River formation—fracturing which extends upwards to the surface—or to a pattern of outwash gravel distribution which has been influenced by the trend of the Hinsdale fault. Springs in the northern plain supply stock water at rates of 10 to 20 gpm, with reported extremes of one and 350 gpm.

Southern Bowdoin Plain. The Southern Bowdoin plain is a continuation of the northern plain but separated on the surface by the floodplain of the Milk River. Only a few wells have been located in the Judith River bedrock and even fewer in what may be outwash sands and gravels over Bearpaw shale. Near the shoreline of the Fort Peck Reservoir are conspicuous hills (Larb Hills) of Hell Creek-Fox Hills sandstones. There are no records of wells drilled on top of these hills but several Judith River water wells have been reported in the intervening valleys. These wells are 1,000+ feet deep and flow 5 to 10 gpm.

Springs are common on the Larb Hills and in intervening valleys. At higher levels the springs are located in stream cuts and coulees where erosion has breached and exposed subsurface sandstone conduits. Springs are also located in the area of Judith River bedrock south of the Milk River. The maximum reported flow was 500 gpm, with about 15 gpm being most common. Springs are not reported in the area of thick Bearpaw shale bedrock.

GROUNDWATER AVAILABILITY AND USE

Based on the number of appropriations in the files of the Administrator there is an abundance of groundwater available at shallow depths in Valley County for domestic and stock use and limited irrigation. Municipal water supplies in the county are derived almost entirely from wells. Thus for the aquifers in the buried valley fill of the preglacial Missouri River, under the present Milk River floodplain, have undergone the most development. Gravel beds within the fill which might attain a saturated thickness in excess of 20 feet, and are not filled with silts, sands, and clays could probably yield 1,000 gpm through properly constructed wells. The capacity for a large sustained yield is unknown due to the inferred discontinuity of the valley fill aquifers. The thickest gravel aquifers apparently are in the deepest channels of the preglacial Missouri Valley, resting on bedrock. The water in alluvium aquifers has been determined by the State Department of Health to have total dissolved solids in amounts of less than 1,000 ppm (parts per million) to more than 3,500 ppm. The highly variable chemical quality is another indication of discontinuity of aquifers. Only a few wells might be classified as sources of "fair to good" quality water, but almost every well could be used as a source of stock water. The chemical constituents with the highest concentrations are sodium, bicarbonate, and sulfate; other common constituents are calcium and magnesium.

The upper reaches of major tributaries contain very shallow sands and gravels which collect runoff. Tributary alluvium becomes more impervious in a downstream direction while upstream sands and gravels can supply small yields of fair quality water, at least temporarily. Alluvium of major tributaries and outwash deposits can be important aquifers in areas where bedrock at the surface is a thick interval of Bearpaw shale or Claggett shale because the next underground aquifer will be at an excessive drilling depth.

Potable water in small quantities is available at shallow depths in outwash gravels on the glaciated plain but these aquifers can be considered reliable only if sources of adequate recharge exist. This means that such aquifers usually are in low areas such as tributary drainage-cuts which receive periodic runoff and retain a portion of this as "recharge."

The Flaxville gravels are a shallow source of good water. Available data is not adequate to evaluate the groundwater potential of this formation. These gravels are similar to the gravels of the Big Flat in Blaine County which support some irrigation, and the Flaxville gravels in Valley County might have a high-yield potential sufficient for local irrigation. Numerous springs are found on the Flaxville plain which are due in part to the saturation of widespread gravel deposits.

The Fort Union, Hell Creek, and Fox Hills formations contain shallow aquifers and numerous wells have been drilled to tap these sources of groundwater in the eastern part of the county. Well-yields are small but sufficient for domestic and stock use. The Flaxville gravels overlie each of these formations locally.

Judith River sandstone wells are common but not numerous, and are found in areas where topography is low enough to restrict drilling depths to less than 1,000 feet, or where geologic structure brings the aquifers close to the surface. Using the figures of 100 feet of gross effective sandstone reservoir and 15% average porosity, it is estimated that every square mile of Valley County underlain by the complete Judith River formation holds in storage about 10,000 acre-feet of water. Almost the entire county is underlain by the Judith River formation. However, only a small portion (perhaps 15%) of this water is estimated to be economically available through wells. Annual recharge to the Judith River formation is mainly by precipitation and is small. The effectiveness of Judith River aquifers is due to the great lateral extent of the formation and artesian pressure which "subsidizes" pumping costs. Judith River water in the eastern plains area has not been appropriated, according to records, probably due to excessive drilling depths. Water in the Judith River formation reportedly has total dissolved solids in amounts of 2,500 ppm to more than 4,000 ppm. The chemical constituents in the water are similar to those in the shallow groundwater, with exceptional increases in the amount of chloride.

The deeper bedrock formations have a ground water potential which has not been evaluated. Sandstones in the Kootenai formation at depths of 2,500 to 4,000 feet may contain a very large supply of artesian water. The quality of Madison water at depths of 6,500 to 7,500 feet appears to deteriorate in an eastward direction due to an influx of subsurface saline water. This water can be considered as having a future potential for industrial use but some pre-use treatment may be necessary. Future advances in technology may even permit this large supply of water to be treated for domestic use if other sources are depleted; sources deeper than the Madison can be utilized at least locally, providing the cost of obtaining this water is not prohibitive.

The people of Valley County have made excellent use of groundwater available through springs. More than 200 springs in the county have been recorded, on the basis of appropriations of groundwater for domestic and livestock uses, and even limited irrigation use. Flows from individual springs have been reported at two to 500 gpm, with the range 10-20 gpm (14,400-28,800 gallons per 24-hour day) being most common. Some springs have been in use since earlier than the year 1900. Many springs are reported to be perennial. The amount of spring water appropriated for use annually is estimated to be in excess of 1,200 acre-feet, which is an average of more than 1,000,000 gallons per day. Spring water not consumed or impounded recharges groundwater aquifers and also adds to the available surface water supply. Spring water is of "fair to good" quality, with total dissolved solids reported at about 700 ppm. Higher amounts of solids have been measured, with the increase due mainly to a higher content of dissolved sodium.

The use of groundwater in Valley County is related to an agricultural economy (principally livestock raising). If future activities so warrant, at least two shallow aquifers might be further developed for moderate yields, and at least one deep aquifer appears capable of large sustained yields.

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ECONOMIC MINERAL DEPOSITS

Geologic Situation

Economic mineral deposits—metallic, nonmetallic, mineral fuels, and ground water—are directly related to the geology of a given area. The geologic situation in Valley County is therefore summarized before the resources are considered.

Valley County is situated within the Northern Great Plains physiographic province, which may also be called the high plains province. There are no mountains within the county, and the terrain is typically a high plain dissected by stream valleys.

The only well-defined geologic structure is the east portion of the Bowdoin dome. Another structure, the Hinsdale fault, trends northeast across the Milk River valley near Hinsdale, but it is not easily detectable.

In most of the county, a surficial cover of glacial drift conceals the bedrock, which is dominantly Bearpaw Shale. Below the Bearpaw are the Judith River Formation and the Claggett Shale; these units are exposed in places along the sides of the valleys of the Milk River and Larb Creek. The Fox Hills Sandstone rests on the Bearpaw and is in turn overlain by the Hell Creek Formation. The Fox Hills-Hell Creek strata may be seen in scattered exposures rising above the general terrain north of Fort Peck Reservoir in the southwest part of the county, and they are also present north of Wolf Point and extend from there to the approximate center of the north county boundary. Strata of the Fort Union Formation overlie the Hell Creek but occur only in the northeast part of the county. Finally, above the Hell Creek and Fort Union but below the glacial drift (where present) there occurs an extensive deposit of gravel known as the Flaxville Gravel. It occupies fairly broad areas north of the Milk-Missouri River Valley and especially in the Opheim-Glentana region.

Natural Gas

The only mineral fuel produced commercially in Valley County is natural gas from the Bowdoin gas field. The field was first discovered by a water well drilled by Martin in 1913. The discovery well (Sec. 18, T. 31N., R. 35E.) was drilled in Phillips County, but the field was subsequently expanded and now extends for several miles into Valley County. Gas is produced from the Bowdoin and Phillips Sandstone zones of the Colorado Group (Cretaceous). About 400 wells have been drilled, and in 1966 the Bowdoin field produced 2,148,063 Mcf of natural gas.

The large area of Valley County has relatively few exploratory drill holes. According to the Annual Report of the Montana Oil and Gas Conservation Commission, only two holes were drilled in 1966. Considering the sparse exploration drilling, the petroleum potential of Valley County has hardly been tested.

Coal

Lignite has been mined from the Fort Union near Glentana, but there is no commercial coal production at present. The Fort Union has not been explored extensively in Valley County, but coal deposits are not likely to be commercial, as the better coal seams in the upper (Tongue River) member of the Fort Union were mostly removed during the erosion interval preceding deposition of the Flaxville Gravel. The U. S. Geological Survey coal map of Montana does show the Fort Union Coal Region extending into northeastern Valley County, however.

Bentonite

Bentonite is a variety of sedimentary rock that is composed of a specific clay (montmorillonite), which has been formed by the alteration of volcanic ash. Bentonite can be easily recognized in the field because it weathers to form a granular material resembling popcorn. Most exposures of bentonite are sparsely vegetated and become very slippery when wet.

Although bentonite has a wide variety of uses, most of the interest in the bentonite in Valley County has been in connection with taconite pelletizing. In this process bentonite is used to bind very fine particles of iron ore together to form small pellets.

The bentonite deposit southwest of Glasgow has been of interest for several years, but only since 1965 has this deposit been developed. A plant to process this bentonite is now planned in the area.

A large part of the area between the Milk and Missouri Rivers is underlain by the Bearpaw Shale. This formation contains numerous beds of bentonite, and most of the exploration to date has been of this formation.

Sand and Gravel

Deposits of sand and gravel are fairly widespread within the alluvium and the Flaxville Gravel, but most of the material must be washed to remove clay and soil before it can be used.

Metals

Valley County has produced no metals and seems unlikely to produce any in the foreseeable future.

SOIL AND WATER CONSERVATION DISTRICTS

Valley County is served by the Valley County Soil and Water Conservation District which was organized in 1945 as the Nashua Soil Conservation District and later enlarged to include the entire county and named the Valley County Soil and Water Conservation District. It covers an area of approximately 3,040,000 acres.

The District is governed by a board of five supervisors who are elected for three (3) year terms by land occupiers of the District and serve without pay. They carry out a program of complete resource conservation including erosion control, water conservation, soil management, land improvement, wildlife management, recreation and land adjustment to proper use. This program is accomplished by providing technical assistance to groups and individual farmers and ranchers, on a voluntary basis, the analyzing of all resources, and planning and applying of economically sound conservation treatment.

Under State law, the supervisors have the power to call upon local, State and Federal agencies to assist in carrying on a soil and water conservation program. The Valley County Soil and Water Conservation District has a memoranda of understanding with the Soil Conservation Service, State Forestry Department, Bureau of Land Management, State Fish and Game Department, and the Department of Interior to provide technical assistance to District cooperators in carrying out sound soil and water conservation programs. Close working relations are maintained with the Farmers Home Administration, Agricultural Stabilization and Conservation Service, State Fish and Game Department and the Technical Action Panel for Rural Area Development.

The U. S. Soil Conservation Service assists the District by furnishing and interpreting basic data on soils and plant cover and other land features. Technical data are interpreted in terms of acceptable alternative land uses and treatment to help guide the farm and ranch operations in developing sound individual or group conservation plans and Great Plains Contracts. It also aids cooperators in design and installation of conservation measures requiring engineering and other technical skills beyond the experience of the individual farmers or ranchers involved.

An important function of the District is to inform all citizens of the benefits derived from the wise use of the communities soil and water resources. The Montana Extension Service assists the District with this important information and education program.

Cost sharing for many conservation practices is available through the Great Plains Conservation Program and the Agricultural Conservation Program. Conservation loans are available through the Farmers Home Administration.

The State Fish and Game Department cooperates in matters involving streams, lakes, ponds, and other wildlife aspects of the program.

One of the major problems of the District is to acquaint the urban as well as rural people of the need for broad based planning of resource conservation and development. The benefits to be derived therefrom include upgrading the quality of the environment, pollution abatement, development of recreational opportunities, enhancement of natural beauty, helping to find solutions to America's water problems, and strengthening the economy and standards of living in rural America.

Technical phases of the District's program includes detailed soil surveys, range site and range condition classes, ground water investigations, drainage studies, irrigation potentials, topographic and other engineering surveys. By a careful analysis of this basic resource information, proper land use and needed conservation treatment of each field can be determined. The technicians interpret the surveys and provide the District cooperator with alternatives in land use and treatment that will enable him to treat the hazards and limitations that occur on each tract of land. With this information and by counseling with technicians, the cooperator makes the final decisions. These decisions are recorded in the Conservation Plan or Great Plains Contract. The cooperator determines what will be done on his farm or ranch and when the jobs will be carried out.

After the Conservation Plan or Great Plains Contract is prepared the cooperator is given further technical assistance on design and layout work essential in establishing conservation practices on the land as called for in the Plan or Great Plains Contract. This technical assistance is provided without cost to the cooperating farmer or rancher.

There are approximately 35,000 acres of irrigated cropland, 680,000 acres of non-irrigated cropland, 1,284,000 acres of pasture and rangeland, 16,819 acres of woodland and 20,370 acres of other lands (such as farmsteads, idle lands, wildlife areas, roads and other areas not classified as cropland, range or pasture) on which the District shares the Conservation responsibility.

By 1975 it is estimated that the land under irrigation will double in the county and this will put a greater demand on our already short water supply. The District Supervisors strongly recommended that a firm program of conservation measures such as irrigation water management, consolidation of ditches and ditch lining be adopted to reduce needless waste of irrigation water.

There are 1,133,735 acres of federal lands (Bureau of Land Management, Bureau of Reclamation, Bureau of Indian Affairs, U. S. Bureau of Sport Fisheries and Wildlife and Air Force) and 208,-080 acres of State land in the District. This land is largely range and pasture.

The major enterprises on agricultural lands in the county are livestock and small grain production. The irrigated lands are used primarily for hay production with some small grain and irrigated pasture being produced. Much of the grazing for beef and sheep production is provided by relatively new and growing enterprise in the District is the fattening of beef cattle for market.

Work done since the organization of the District on cropland consists largely of improved cropping systems, improved management of crop residues, improvement and installation of irrigation systems, seeding of pasture and hayland to adapt grasses and legumes, installation of water and erosion control structures, farm drainage systems, soil management, and improvement of wildlife habitat. On dryland pasture and range the work has consisted of water development and improvement of wildlife habitat.

Since the formation of the District in 1941 it has provided assistance on proper cropping systems and residue management on 162,964 acres, installation of 210 surface irrigation systems, one irrigation tailwater recovery system, 21,815 acres of irrigation land leveling, 263 miles of irrigation canal and field ditches, 72 irrigation storage reservoirs, four multi-purpose reservoirs, 18,191 acres of hay and pasture planting, pasture and range management on 587,000 acres, 1,024 ponds for livestock water, 286 springs developed, 13,645 feet of pipeline for livestock water, 229 wells, 11,500 acres of range seeding, 586 acres of farmstead and feedlot windbreaks planted, 8 miles of field windbreaks, 12 farm ponds stocked with fish, wildlife habitat preservation (natural areas) on 1,264 acres and 345 acres of new wildlife habitat developed, waterspreading on 10,243 acres, 1,481 acres of contour stripcropping, 5 acres of recreation area land grading and planting, 162,964 acres of stubble mulching, 452,346 acres of wind stripcropping, 1,000 feet of recreation area access road, 129 pumping plants for water control, 245 acres of grassed waterway and outlets, 10,580 feet of flood water diversions, two flood water retarding structures, two grade stabilization structures, 81 miles of firebreaks, 10,528 acres of range deferred grazing, two non-commercial recreation developments and 11 public recreation developments.

A Conservation Needs Inventory was completed in 1959 for Valley County as a part of a National Inventory of Conservation Needs. In Valley County, it was estimated that about 50% of dry cropland, 70% of irrigated cropland, and 95% of grassland were in need of additional conservation treatment.

A considerable amount of conservation work done to date has been accomplished by working with individual farmers and ranchers and through their individual efforts. They are now finding

that larger problems can be solved and more accomplished through organized group efforts and this is encouraged wherever possible.

Cooperative efforts of land owners and operators, local, state, and federal agencies, civic organizations, local businessmen, news media, and the dedication of the District Supervisors has contributed to the overall success of the District.

FISH AND GAME

Game

Diversity of game characterized this county rather than spectacular abundance. Thus, we find good numbers of sage grouse, sharptailed grouse, and Hungarian partridge in most parts of the county. Pheasants are less numerous and confined mostly to the farming areas along the Milk River. The wild turkey has been transplanted into the Pines Area of the Missouri River breaks, but its fate is still uncertain.

Perhaps the most popular species of big game in the county is the elk, which was introduced from the Yellowstone Park herd in 1951 and has since provided excellent hunting and tremendous trophy bulls.

Mule deer are the most numerous of the big game animals, occupying all of the rough breaks along Fort Peck Reservoir as well as the coulees bordering all major streams. Whitetailed deer, on the otherhand, are mostly confined to the Milk River, Frenchman Creek, Rock Creek, and a few other smaller stream bottoms. Antelope are found throughout the county, but in relatively low numbers.

Many stock watering reservoirs in the county furnish nesting habitat for waterfowl. In recent years, Canada geese have made increasing use of these reservoirs for nesting.

Duck Creek below Fort Peck Dam is a major wintering area for mallards. As many as 30,000 have been known to spend the winter there.

Fish

The most outstanding feature of the Valley County fishery resource is provided by Fort Peck Reservoir. Excellent fishing for northern pike, sauger, crappie and perch is provided; rainbow trout, drum, catfish, and ling also frequent the creel.

River fishing is provided by the Milk and Missouri Rivers. Fair to good fishing is present in the Milk River for sauger, walleye, and catfish on a seasonal basis. However, excellent fishing for these species is found where the Milk River enters into the Missouri River. Fishing for sauger and walleye in the spring is extremely good in the Fort Peck Trailrace. Sturgeon and ling are also taken occasionally in this area.

The dredge cut ponds below Fort Peck Dam offer fair fishing for walleye, sauger, and northern pike. Fishing for catfish on a seasonal basis is very good. These dredge cut ponds contain an excellent paddlefish population for interested bow and arrow fishermen.

Trout fishing is provided at the Dredge Cut Trout Pond and other small reservoirs scattered throughout the area.

Additional fishing opportunities are provided by small reservoirs throughout the area containing bass and northern pike.

SUMMARY OF IRRIGATED LAND BY RIVER BASINS IN THE FOLLOWING COUNTIES COMPLETED TO DATE

Big Horn, Blaine, Broadwater, Carbon, Carter, Cascade, Chouteau, Custer, Deer Lodge, Fallon, Flathead, Gallatin, Golden Valley, Granite, Hill, Jefferson, Judith Basin, Lake, Lewis & Clark, Lincoln, Madison, Meagher, Missoula, Musselshell, Park, Phillips, Pondera, Powder River, Powell, Ravalli, Rosebud, Silver Bow, Stillwater, Sweet Grass, Teton, Treasure, **Valley**, Wheatland, Wibaux, and Yellowstone

RIVER BASIN Missouri River Drainage Basin	Present Irrigated Acres	Irrigable Acres Under Present Facilities	Maximum Irrigated and Irrigable Acres Under Present Facilities
*Missouri River	134,575.50	26,711.33	161,286.83
Jefferson River	61,291.00	9,713.00	71,004.00
Beaverhead River	40,771.00	6,076.00	46,847.00
Big Hole River	23,775.00	1,950.00	25,725.00
Madison River	39,445.00	7,660.00	47,105.00
Gallatin River	112,054.00	21,242.00	133,298.00
Smith River	32,934.00	19,679.00	52,613.00
Sun River	124,474.58	4,385.00	128,859.58
Marias River	114,823.42	13,445.88	128,269.30
Teton River	74,653.00	15,882.33	90,535.33
Musselshell River	64,789.00	57,870.00	122,659.00
Milk River	212,009.62	48,867.76	260,877.38
Yellowstone River**	303,657.00	96,016.00	399,673.00
Stillwater River**	30,423.50	8,028.53	38,452.03
Clarks Fork River**	88,160.97	1,530.83	89,691.80
Big Horn River**	65,005.00	23,858.00	88,863.00
Tongue River	28,170.00	7,762.00	35,932.00
Powder River	35,948.00	2,299.00	38,247.00
Little Missouri River	42,513.00	1,499.00	44,012.00
Grand Total Missouri River Basin	**1,629,472.59**	**374,475.66**	**2,003,948.25**
Columbia River Drainaga Basin			
Columbia River	0	0	0
Kootenai (Kootenay) River	9,914.13	968.00	10,882.13
Clark Fork (Deer Lodge) (Hellgate) (Missoula) River	146,287.70	14,934.20	161,221.90
Bitter Root River	111,102.43	3,200.00	114,302.43
Flathead River	135,907.19	4,532.22	140,439.41
Grand Total Columbia River Basin	**403,211.45**	**23,634.42**	**426,845.87**
GRAND TOTAL COUNTIES COMPLETED TO DATE	**2,032,684.04**	**398,110.08**	**2,430,794.12**

*Name of streams indented on the left-hand margin indicate that they are tributaries of the first stream named above which is not indented.

**Figures in these River Basins revised by resurvey of Carbon County, 1965.

IRRIGATION SUMMARY OF VALLEY COUNTY BY RIVER BASINS

MISSOURI RIVER BASIN	Present Irrigated Acres	Irrigable Acres Under Present Facilities	Maximum Irrigated and Irrigable Acres Under Present Facilities
Missouri River	14,027.00	173.00	14,200.00
Timber Creek	1,090.00	0.00	1,090.00
Slough	10.00	0.00	10.00
Milk River	28,117.00	5,305.00	33,422.00
Frenchman Creek	754.00	0.00	754.00
Brush Coulee	25.00	0.00	25.00
Three Chimney Coulee	15.00	0.00	15.00
Panhandle Coulee	34.00	0.00	34.00
Beaver Creek	473.00	0.00	473.00
Larb Creek	327.00	0.00	327.00
Craig Coulee	336.00	0.00	336.00
Unnamed Coulee	57.00	0.00	57.00
Unnamed Coulee	84.00	0.00	84.00
Unnamed Coulee	3.00	0.00	3.00
Coon Coulee	258.00	264.00	522.00
Square Creek	0.00	0.00	0.00
Unnamed Coulee	35.00	0.00	35.00
Jernigan Coulee	45.00	0.00	45.00
First Creek	345.00	0.00	345.00
Slough Spring	13.00	0.00	13.00
Total Beaver Creek and Tributaries	**1,976.00**	**264.00**	**2,240.00**
Rock Creek	9,386.00	40.00	9,426.00
Horse Creek	271.00	0.00	271.00
Unnamed Coulee	58.00	0.00	58.00
South Creek	76.00	0.00	76.00
McEachran Creek	688.00	0.00	688.00
Unnamed Coulee	160.00	0.00	160.00
Unnamed Coulee	45.00	0.00	45.00
Unnamed Coulee	23.00	0.00	23.00
Unnamed Coulee	37.00	0.00	37.00
Bluff Creek	41.00	0.00	41.00
Unnamed Coulee	44.00	0.00	44.00
West Fork Bluff Creek	81.00	0.00	81.00
Unnamed Coulee	7.00	0.00	7.00
Unnamed Coulee	36.00	0.00	36.00
Unnamed Coulee	9.00	0.00	9.00
Jones Coulee	10.00	0.00	10.00
Short Coulees	5.00	0.00	5.00
Jensen Coulee	52.00	0.00	52.00
Crow Creek	79.00	0.00	79.00
Barton Coulee	25.00	0.00	25.00
Badland Coulee	97.00	0.00	97.00
Duncan Coulee	44.00	0.00	44.00
Big Sage (Olmes) Creek	20.00	0.00	20.00
West Fork Big Sage Creek	9.00	0.00	9.00

*Name of streams indented on the left-hand margin indicate that they are tributaries of the first stream named above which is not indented.

IRRIGATION SUMMARY OF VALLEY COUNTY BY RIVER BASINS

MISSOURI RIVER BASIN—(Continued)	Present Irrigated Acres	Irrigabla Acres Under Present Facilities	Maximum Irrigated and Irrigable Acres Under Presant Facilities
Snake Creek	0.00	0.00	0.00
Unnamed Coulee	44.00	0.00	44.00
Holst Coulee	14.00	0.00	14.00
Unnamed Coulee	41.00	0.00	41.00
Little Snake Creek	0.00	0.00	0.00
East Fork (Jordan) Creek	140.00	0.00	140.00
Unnamed Coulee	15.00	0.00	15.00
Willow Creek	335.00	0.00	335.00
Coyote Coulee	26.00	0.00	26.00
Spring Coulee	68.00	0.00	68.00
Unnamed Coulees	57.00	0.00	57.00
Unnamed Coulee	15.00	0.00	15.00
Unnamed Coulee	0.00	0.00	0.00
White Spring	12.00	0.00	12.00
Papoose Creek	143.00	0.00	143.00
Unnamed Coulee	78.00	0.00	78.00
Cash Creek	68.00	0.00	68.00
Turnip Creek	64.00	0.00	64.00
Big (Bell) Coulee	92.00	0.00	92.00
Anderson's Coulee	112.00	0.00	112.00
Unnamed Coulee	25.00	0.00	25.00
Middle Fork Cash Creek	77.00	0.00	77.00
Well	8.00	0.00	8.00
Whitebread Coulee	0.00	0.00	0.00
Unnamed Coulees	70.00	0.00	70.00
Halbert Coulee	598.00	0.00	598.00
Total Rock Creek and Tributaries	13,405.00	40.00	13,445.00
Well	9.00	0.00	9.00
Milk River Slough	85.00	0.00	85.00
Bear Creek	253.00	0.00	253.00
Black Coulee	35.00	0.00	35.00
Lime Creek	390.00	0.00	390.00
Black Tail Coulee	155.00	0.00	155.00
Long Coulee	0.00	0.00	0.00
Lund Coulee	55.00	0.00	55.00
Hay Coulee	552.00	0.00	552.00
Buffalo Coulee	99.00	190.00	289.00
Spring Coulee	93.00	0.00	93.00
Buggy Creek	122.00	0.00	122.00
Spring Creek (Big Spring Cle.) (Little Spring Cle.)	232.00	0.00	232.00
Unger Coulee	0.00	0.00	0.00
West Fork Unger Coulee	150.00	0.00	150.00
Gravel Coulee	60.00	0.00	60.00
Antelope (Dry Run) (Dry) Creek	227.00	0.00	227.00
West Fork Dry Run (N. FK Antelope) Creek	97.00	0.00	97.00
McGregor Coulee	0.00	0.00	0.00
Lone Tree Coulee	23.00	0.00	23.00

IRRIGATION SUMMARY OF VALLEY COUNTY BY RIVER BASINS

MISSOURI RIVER BASIN—(Continued)	Present Irrigated Acres	Irrigable Acres Under Present Facilities	Maximum Irrigated and Irrigable Acres Under Present Facilities
Hard Scrabble (N. FK. Antelope) Creek	41.00	0.00	41.00
Unnamed Coulee	14.00	0.00	14.00
Traux Coulee (N. Br. Dry Run) (Moose) Creek	0.00	0.00	0.00
Mott Coulee	24.00	0.00	24.00
Unnamed Coulee	78.00	0.00	78.00
Richardson Coulee	32.00	0.00	32.00
Brazil (Palmira) Creek	716.00	0.00	716.00
Little Brazil (E. Br. Brazil) (Lindenton) Creek	100.00	296.00	396.00
West Fork Brazil Creek	5.00	0.00	5.00
No Name Creek	5.00	0.00	5.00
Cherry Creek	256.00	0.00	256.00
East Fork Cherry Creek	46.00	0.00	46.00
Unnamed Coulee	10.00	0.00	10.00
Harley (Spring) (Mooney) Coulee	0.00	95.00	95.00
Well	34.00	0.00	34.00
Willow Creek	0.00	181.00	181.00
South Fork Willow Creek	144.00	0.00	144.00
Unnamed Coulee	60.00	0.00	60.00
Lone Tree Creek	1,562.00	0.00	1,562.00
Second North Fork Lone Tree Creek	822.00	0.00	822.00
Unnamed Coulee	106.00	0.00	106.00
Bomber Creek	68.00	0.00	68.00
Unnamed Coulee	145.00	0.00	145.00
Dog Creek	550.00	0.00	550.00
Mud (Muddy) Creek	0.00	0.00	0.00
Wilderness Coulee	175.00	0.00	175.00
Little Beaver (Beaver) Creek	200.00	0.00	200.00
Unnamed Coulee	130.00	0.00	130.00
Mud Creek	0.00	0.00	0.00
Willow Flat	1,462.00	0.00	1,462.00
Hasford Coulee	21.00	0.00	21.00
Total Willow Creek and Tributaries	5,445.00	181.00	5,626.00
Dog (Dogy) (Doga) Creek	0.00	0.00	0.00
Long Lake	28.00	0.00	28.00
Slough	119.00	94.00	213.00
Porcupine Creek	0.00	41.00	41.00
Middle Fork Porcupine Creek	0.00	0.00	0.00
Alkali Creek	29.00	0.00	29.00
Snow (W. FK. Snow) Coulee	158.00	0.00	158.00
North Fork Snow (Bog) Coulee	123.00	10.00	133.00
East Fork Snow Coulee	69.00	0.00	69.00
Total Milk River and Tributaries	54,295.00	6,516.00	60,811.00
Little Porcupine Creek	508.00	0.00	508.00
Oswego Creek	90.00	0.00	90.00
Poplar River	0.00	0.00	0.00
West Fork Poplar River	0.00	0.00	0.00
Roanwood Coulee	0.00	0.00	0.00
Unnamed Coulee	0.00	0.00	0.00
Area Drainage	30.00	0.00	30.00
Hell Coulee	20.00	0.00	20.00
Unnamed Coulee	26.00	0.00	26.00
GRAND TOTAL MISSOURI RIVER—VALLEY COUNTY	70,096.00	6,689.00	76,785.00

FORT PECK IRRIGATION PROJECT

(Including Wiota and Frazer-Wolf Point Units)

HISTORY

The development of irrigation on the Fort Peck Reservation was authorized by the Act of May 30, 1908 (35 Stat. 558). Construction of irrigation works began in June 1908, under the direction of the United States Reclamation Service. By 1921 four irrigation units, viz: Little Porcupine, Big Porcupine, Poplar River and the Big Muddy were developed. These units were named after the respective tributaries to the Missouri River from which water supply is obtained.

The natural flow of these streams was too small to supply irrigation needs. The Reclamation Service (later called the Bureau of Reclamation) recognized this deficiency and provided in their original plans for the construction of two reservoirs, one on the Little Porcupine and another on the Big Porcupine. Plans were for a third reservoir which was to be located on the Poplar River but it was never constructed.

In March 1924 all operating units were turned over to the Bureau of Indian Affairs.

The Big Porcupine Reservoir was located about 40 miles upstream from the irrigation unit, and as a result, a considerable portion of the released water was lost enroute. The spillway was damaged in 1925 and was completely destroyed in 1928. In 1930 it was rebuilt but washed out again in 1939 along with most of the dam and has not been repaired since that time.

In 1931 a pumping plant was installed in the Milk River near Wiota which made delivery to the lower portion of the Big Porcupine Unit. After the first failure of the reservoir, and because of the severe water shortage, irrigation was discontinued on that portion of the unit lying above the Wiota Pump. The part of the unit below the pump has continued in operation until the present time. The old Wiota Pumping Plant was discontinued in 1965 when the new Wiota Pumping Plant was constructed. This latter plant took water from a more dependable source, the Missouri River, and has a capacity of pumping 120 c.f.s.

Construction was started on the Frazer-Wolf Point Unit in 1936. The main structure on this unit is the pumping plant which lifts the water directly from the Missouri River into the Main Canal.

The Little Porcupine Unit is the only one of the original units still operating as originally designed (now included as a division of the Frazer-Wolf Point Unit). Its primary water supply is the Little Porcupine Reservoir. A supplementary water supply is furnished by the Frazer Re-lift Pumping Plant constructed in 1966.

Operation and maintenance activities have been discontinued on both the Poplar and Big Muddy Units due to inadequate water supply. The structures and laterals on the Big Muddy Unit are completely inoperative and no attempt is being made to irrigate any of the land in this unit. Most of the facilities built to serve the Poplar River Unit are in the same condition. However, a small acreage on the west side of the Poplar Unit has been irrigated by individual landowners.

The Fort Peck Irrigation Project, as it now exists consisting of the Wiota and Frazer-Wolf Point Units, is scheduled for completion by the end of the fiscal year 1969. The project will furnish water to some 25,000 acres of irrigable lands. Upon completion of the project, negotiations will be made for the transfer of the project from the Bureau of Indian Affairs to the Wiota and Oswego Water Users Associations as a Water Users District.

PRESENT STATISTICS:

Location: This project is located in the southwestern portion of the Fort Peck Indian Reservation along the Milk River and Missouri River bottoms in Valley and Roosevelt Counties, northeastern Montana.

Lands irrigated under the Wiota Unit (Big Porcupine) are in Sections 22-28 inclusive, and 34-36 inclusive, T. 27N - R. 42E; Section 1, T. 26N - R. 42E; Sections 30-33 inclusive, T. 27N - R. 43E; Sections 3-6 inclusive, T. 26N - R. 43E.

The Frazer-Wolf Point Unit's irrigated land is located in Sections 1 and 12, T. 26N - R. 44E; Sections 1-12 inclusive, T. 26N - R. 45E; and Sections 25, 32-36 inclusive, T. 27N - R. 45E.

The Little Porcupine Unit (now included as a division of the Frazer-Wolf Point Unit) has land irrigated in Sections 35 and 36, T. 27N - R. 44E; Section 1, T. 26N - R. 44E; and Section 6, T. 26N - R. 45E.

Length and Capacity of Canals: On the Wiota Unit a total of 46.9 miles of canals and laterals are presently in use with approximately 7 miles yet to be constructed to complete the system. The new Wiota Pumping Plant, which delivers water to this unit from the Missouri River, has a capacity of 120 c.f.s. The main canal of this unit known as the Keubler Canal is of a sufficient capacity to carry the 120 c.f.s. from the pumping plant. This canal has a length of 7.5 miles. Location of the pump on the Missouri River is in the SE¼SE¼ of Section 2, T. 26N - R. 43E.

The Frazer-Wolf Point Unit has a total of 100 miles of main canals and laterals which are presently in use, with 14.5 miles yet to be constructed to complete the system. Presently the pumping capacity of this unit is 200 c.f.s. but the planned installation of an additional pump will raise the pumping capacity to 275 c.f.s. The main canal of the Frazer-Wolf Point Unit has a length of 8.75 miles in Valley County and an initial capacity to carry the planned 275 c.f.s. The Pumping Plant for this unit is on the left bank of the Missouri River in the SW¼SE¼ of Section 2, T. 26N - R. 44E.

The Little Porcupine Division of the Frazer-Wolf Point Unit has a total of 6.5 miles of canal and laterals in use with 1.5 miles yet to be constructed to complete the system. The Little Porcupine "Canal A" from Little Porcupine Creek to the Little Porcupine Reservoir has a length of 1.25 miles and from the reservoir it is about 1 mile long before it splits into a series of laterals. A Re-lift Pumping Plant has been constructed to supplement the water supply to this division from the main canal of the Frazer-Wolf Point Unit. This Re-lift Pumping Plant has a capacity of 10 c.f.s

Size and Capacity of Reservoirs: The only reservoir still in use by the project is the Little Porcupine Reservoir with a capacity of 4,000 acre-feet and covers a surface area of 380 acres.

Operation and Maintenance: The water charge per acre on this project includes both operation and maintenance and the cost of pump water. The charges on the Fort Peck Irrigation Project are the same for both the Wiota-Frazer-Wolf Point Units which is $4.00 per acre-foot.

Present Water Users: On the Fort Peck Irrigation Project in 1964 there were approximately 381 water users under the Wiota, Frazer-Wolf Point Units combined.

Acres Irrigated: In 1967 the Water Resources Survey found on the Fort Peck Irrigation Project a total of 5,560 acres irrigated for the Wiota Unit; 4,974 acres irrigated for the Frazer-Wolf Point Unit; and 508 acres irrigated for the Little Porcupine division of the Frazer-Wolf Point Unit.

The irrigation office of the Fort Peck Indian Reservation lists an additional 4,500 acres of irrigable land under these units in Valley County. However, this acreage was not included in the maximum irrigable acres for Valley County by our survey. Most of this acreage will require additional

lateral ditches, land leveling, etc., before water is applied to the land. For this reason it was not classified as potentially irrigable acres under present ditch facilities.

WATER RIGHT DATA

Milk River

A treaty was entered into between Great Britain and the United States on January 11, 1909. It provided for division of water of St. Mary and Milk Rivers between the United States and Canada. The waters of the Milk River are divided equally between the two countries except during the irrigation season when the United States is entitled to a prior appropriation of 500 c.f.s., or as much water as constitutes 75% of its natural flow. In turn, during the irrigation season, Canada is entitled to a prior appropriation of 500 c.f.s. from the St. Mary River or as much water as constitutes 75% of its natural flow.

A decision to establish the rights or prior appropriation by contract rather than by adjudication on the Milk River was made in 1908 by the United States Bureau of Reclamation. This contract, which involved nearly all of the land irrigated in 1912 became known as the Vested Water Right Contract. Under the terms of this contract, the prior appropriators conveyed all rights to the waters of the Milk River and tributaries to the United States. In return, the United States was to divert water into Milk River and make available for irrigation purposes a quantity sufficient to supply the canals of prior appropriation.

A summation of 1912 water rights and appropriation follows:

MILK RIVER BASIN

	Acres	Second-Feet	Acres-Feet
Vested water right contracts	26,117	66.0	26,117
Individual appropriators	537	2.9	1,074
Municipal use	None	0.7	506
Commercial use (railways)	None	3.5	2,534
Decreed (Fort Belknap Indians)	....	125.0	....

The above tabulation summarizes the water rights recognized in 1912 as being senior to any appropriation by the United States Bureau of Reclamation. The Bureau of Reclamation filed on all remaining water of the Milk River and its tributaries in 1906 and 1908.

For many years landowners adjacent to the Milk River have been developing new acreages to be served by pumping installations. Many of these pump systems were established without contract or agreement with the United States Bureau of Reclamation. It is estimated that non-contract pumpers are annually diverting 9,120 acre-feet of water above Vandalia Dam that is needed by legitimate water users.

The United States Bureau of Reclamation is considering giving, or already has given, contracts to some or all of the pumpers now in operation without contracts.

The following water rights were found by the Water Resources Survey that are applicable to the Fort Peck Irrigation Project. These are as follows:

1. Appropriation by U.S.A. by R. M. Conner, Agent, from the Missouri River dated 11-18-1919 for 40,000 miner's inches. (Reference: Book 16, Miscellaneous Records, page 86).

2. Appropriation by U.S.A. from the Big Porcupine Creek dated 11-26-1916 for 20,000 miner's inches. (Reference: Book 11, Miscellaneous Records, pages 616, 618.)

3. Appropriation by U.S.A. from the Little Porcupine Creek dated 10-31-1913 for 20,000 miner's inches. (Reference: Book 10, Miscellaneous Records, pages 1, 2, 3.)

(See maps in Part II: Wiota Unit pages 9, 10, and 18; Frazer-Wolf Point Unit pages 11, 12, and 20; Little Porcupine Division of the Frazer-Wolf Point Unit pages 11, 12, and 19.)

FRENCHMAN IRRIGATION COMPANY
(Mutual)

HISTORY

The Frenchman Irrigation Company was first incorporated as a company on April 5, 1905. The term of years for the corporation was for a 20 year period and the shares of stock issued by the company totaled 4,800 shares at a par value of $1.00 per share. All of the shares of stock issued were subscribed to by the stockholders in the company.

Among the first water users in the Frenchman Irrigation Company were: Fredrick Groves of Hinsdale and James H. Jordan and Benjamin R. Richardson, both of Saco.

Since April 4, 1925 (after the 20 year period expired for the term of existence for the corporation), the Frenchman Irrigation Company has operated as a mutual ditch company. Shares of stock in the company were reduced from 4,800 shares to 48 shares and the cost per share increased from $1.00 to $100.00 for each share of stock. All of the 48 shares are presently owned by members of the Frenchman Irrigation Company. Under this project water is supplied to all of the water users of the company from the Frenchman Creek Storage Project. Each of the company stockholders are members of the Frenchman Water Users Association, a corporation which enables them to purchase supplemental water from the Frenchman Creek storage reservoir.

The majority of the lands irrigated under this company are located in Phillips County with only two stockholders in this company irrigating land in Valley County.

PRESENT STATISTICS:

Location: The point of diversion of the main canal is in the SE¼SE¼ of Section 22, T. 33N - R. 34E in Phillips County. Land irrigated in Valley County is located in Sections 21, 22, 27, and 28, T. 32N - R. 35E.

Length and Capacity of Canal: From where the main canal enters Valley County it has a length of approximately ¾ of a mile and an initial capacity of 75 c.f.s.

Operation and Maintenance: Charges for operation and maintenance in this canal company vary from year to year and are based on the number of shares owned by the stockholders in the company.

Present Users: In Valley County there are only two water users having stock in the company and one of the stockholders is also a water user in Phillips County.

Acreage Irrigated: In 1967 there were a total of 610 acres irrigated under the company and furnished a supplemental water supply from the Frenchman Creek Storage Project.

WATER RIGHT DATA

In the Frenchman Creek Decree, the Frenchman Creek Irrigation Company was decreed the first 4,440 miner's inches of the water of Frenchman Creek. (Reference: Case #4024, Frenchman Creek and Tributaries, Clerk of the Court's Office, Malta, Montana.)

(See map in Part II; page 38.)

FRENCHMAN CREEK STORAGE PROJECT
(Montana Water Resources Board)

HISTORY

At the request of the local people in the vicinity north of Saco, Montana, the Water Conservation Board authorized a survey of the Frenchman Creek Storage Project on June 2, 1949.

Bids for construction were received on August 3, 1950 and the dam was completed in November 1951. This area, including all of the Milk River drainage suffered a very severe flood in the early spring of 1952. Because of the flood conditions, the reservoir was filled to capacity before there was an opportunity to test the structure. Due to the flood, the spillway and a large section of the west abutment was washed out by the heavy spring run-off.

The Board immediately made plans to repair the structure with financial aid secured from Federal Flood Disaster funds. The dam was repaired in time to store water for the irrigation season of 1953.

One of the requirements of the Water Board in the construction of the project was the formation of the Frenchman Water Users Association. The Association was incorporated for a term of 40 years and its articles filed with the Secretary of State on August 15, 1950. Shares of stock issued for the corporation totaled 10,000 shares at a par value of $1.00 per share. The by-laws of the Association provided for the election of five directors.

Water Purchase contracts for the project were issued for a period of 40 years with an annual payment of 75¢ per acre-foot plus operation and maintenance. It was originally proposed that the Frenchman Irrigation Company would subscribe for 6,000 acre-feet with 1,000 acre-feet available for other lands in the vicinity of the reservoir. There are some lands irrigated above the reservoir by substituting storage water for high priority water rights below the reservoir.

The majority of the lands irrigated under this storage project are located in Phillips County.

PRESENT STATISTICS:

Location: Land irrigated under the Frenchman Water Users Association are in Section 6, T. 34N - R. 35E and Sections 28, and 29, T. 32N - R. 35E. The water is pumped from Frenchman Creek into a gravity ditch system for the irrigation of this land.

Size and Capacity of Reservoir: Frenchman Creek Reservoir has a capacity of 7,010 acre-feet and covers a surface area of 675 acres.

Operation and Maintenance: Under this storage project operation and maintenance charges are 25¢ for each acre-foot of water purchased. Total water charges including operation and maintenance are $1.00 per acre-foot.

Present Users: There is a total of three water users under this association in Valley County, two of which have land in Phillips County.

Acreage Irrigated: In 1967 there were 144 acres irrigated by pump and no potentially irrigable acres listed under this project.

WATER RIGHT DATA

For this storage project the State Water Conservation Board filed an appropriation dated 7-25 1950, for all the unappropriated water of Frenchman Creek. (Reference: Book 1, Water Right Records, page 280, Clerk and Recorder's Office, Phillips County, Montana.)

(See maps in Part II; pages 38 and 44.)

MILK RIVER PROJECT (U. S. BUREAU OF RECLAMATION)
(Including Glasgow and Malta Irrigation Districts)

HISTORY

Irrigation in the Milk River Valley was first initiated by white settlers who built small, private irrigation systems. The first water right filed on the Milk River was in 1889 by T. B. Burns, who in 1890 joined with his neighbors in constructing a community diversion dam in the vicinity of the present Fort Belknap Diversion Dam, just north of Lohman in Blaine County.

In 1891 investigations were started to determine the means of supplementing the low summer flow of the Milk River. It was found that the most feasible plan was the diversion of the St. Mary River water into the headwaters (North Fork) of the Milk River. Both of these rivers, however, run through Canada, which necessitated a water rights agreement with Canada before the plan could be consummated.

Increasing irrigation activities in the Milk River Valley brought urgent requests for the development of a Milk River Project. When the Reclamation Service was established in 1902, the Milk River Project was investigated and this resulted in authorization of the project by the Secretary of the Interior on March 4, 1903.

The St. Mary Storage Unit was authorized by the Secretary of Interior on March 25, 1905, and construction begun on July 27, 1906. The treaty with Great Britain relating to the distribution between Canada and the United States of the waters of the St. Mary and Milk Rivers was signed on January 11, 1909. The Dodson Diversion Dam was completed in January of 1910 and the first water delivered for irrigation in the season of 1911.

Dams were completed on Sherburne Lake, Nelson Reservoir, St. Mary River, and Swift Current Creek in 1915, Vandalia Dam in 1921, and Fresno Dam in 1939. Fresno Dam and Reservoir, formerly called Chain Lakes Dam and Reservoir, was constructed under the National Industrial Recovery Act and approved by the President in August 1955 pursuant to the acts of June 25, 1910, and December 5, 1924.

The Dodson Pumping Unit was approved by the President on March 17, 1944, and under the Water Conservation Act of August 11, 1939, the project was constructed to furnish water for about 1,655 acres of land above the gravity system.

The Milk River Project is located in Glacier, Blaine, Phillips and Valley Counties, Montana. Water is diverted from the St. Mary River and stored in Sherburne Lake and then diverted through a 29-mile canal discharging into the North Fork of the Milk River. It then flows through Canada for 216 miles before returning to the United States. Milk River water is stored in Fresno Reservoir, located 17 miles west of Havre, Montana, and in Nelson Reservoir, located 19 miles northeast of Malta. The water is diverted from the Milk River near Chinook and Harlem into private canals on each side of the river for land in that area, comprising the Chinook Division. Near Dodson, the Dodson North and the Dodson South Canals of the Malta Diversion divert water for irrigation of land in the vicinity of Dodson, Wagner, Malta, and Bowdoin. The Dodson South Canal conveys water for irrigation of land on the Malta Division south of the Milk River and also conveys water for storage in the Nelson Reservoir. From this storage, land is irrigated on the south side of the Milk River and Beaver Creek near Saco and Hinsdale. At the Vandalia Diversion Dam, the Vandalia South Canal follows along the south side of the Milk River, and carries water for irrigation of land near Tampico, Glasgow and Nashua which comprises the Glasgow Division. Land is also irrigated above the level of the gravity system along the Milk River Valley. This is accomplished

by the Dodson Pumping Unit which elevates water from the Dodson North Canal to irrigate additional lands above the gravity system.

The operation of all storage facilities is by the Bureau of Reclamation with funds advanced by the water users.

Malta Division

Except for the storage facilities all water supply and distribution works were constructed, operated and maintained by the Malta Irrigation District. Water is diverted at the Dodson Diversion Dam into the Dodson North and Dodson South Canals. The Dodson South Canal conveys water into the Nelson Reservoir. The Nelson South Canal diverts from the east end of the Nelson Reservoir for the irrigation of land of the Malta District in the Saco and Hinsdale areas of the county.

Glasgow Division

At the Vandalia Diversion Dam, the Vandalia South Canal diverts water for the irrigation of land near Tampico, Glasgow, and Nashua, comprising the Glasgow Irrigation District. All of the water supply and distribution works are constructed, operated and maintained by the Glasgow Irrigation District. The storage works are operated by the Bureau of Reclamation.

PRESENT STATISTICS:

Location: Lands irrigated from the Nelson South Canal comprising the Malta Irrigation District are located in Sections 10, 15, 22-27 inclusive, T. 31N - R. 34E; Sections 3, 4, 9, 10, 13-15 inclusive, 18-30 inclusive, 35 and 36, T. 31N - R. 35E; Sections 27, 33, and 34, T. 32N - R. 35E and Sections 19, 29-32 inclusive, T. 31N - R. 36E.

From the Vandalia South Canal of the Glasgow Irrigation District the lands irrigated are located in Sections 7-9 inclusive, 15, 16, 24 and 25, T. 30N - R. 37E; Sections 19, 30-33 inclusive, T. 30N - R. 38E; Sections 3-5 inclusive, 8-10 inclusive, 14-17 inclusive, 20-28 inclusive, 34-36 inclusive, T. 29N - R. 38E; Sections 19, 29-32 inclusive, T. 29N - R. 39E; Section 1, T. 28N - R. 38E; Sections 3-6 inclusive, 8, 9, 13-16 inclusive, 22-28 inclusive, T. 28N - R. 39E; Sections 19, 28-36 inclusive, T. 28N - R. 40E; Sections 2, 4, and 5, T. 27N - R. 40E; Sections 28, 29, 31-34 inclusive, T. 28N - R. 41E; Sections 1-4 inclusive, 10-12 inclusive, T. 27N - R. 41E; and Sections 6 and 7, T. 27N - R. 42E.

Length and Capacity of Canals: Point of diversion of the Nelson South Canal is in Phillips County at the eastern end of the Nelson Reservoir and has a total length of 25 miles, 12 miles of which is in Valley County. It has an initial capacity of 500 c.f.s.

The Vandalia South Canal from the diversion dam has its point of diversion in the SW¼NW¼ of Section 7, T. 30N - R. 37E. The Vandalia South Canal has a length of 42.75 miles and an initial capacity of 300 c.f.s.

Operation and Maintenance: Operation and maintenance charges for the Malta Irrigation District are:

Land Clsss.	O. & M.	Const.	Total
1	$2.80	$1.00	$3.80
2	2.73	.95	3.68
3	2.60	.60	3.20
4a	2.20	.40	2.60
4b	1.45	.25	1.70

Operation and maintenance charges for the Glasgow Irrigation District are:

Land Class	O. & M.	Const.	Total
1	$3.40	$1.00	$4.40
2	3.40	1.00	4.40
3	3.15	.70	3.85
4a	2.20	.40	2.60
4b	2.20	.40	2.60

Present Users: For the Malta Irrigation District in 1967 there were 72 water contracts. Under the Glasgow Irrigation District in the county there were 141 water contracts.

Acreage Irrigated: In 1967 the Malta Irrigation District had a total of 7,443 acres irrigable and 1,469 acres potentially irrigable under present facilities, making a total of 8,912 maximum irrigable acres.

The Glasgow Irrigation District had 15,595 acres irrigable and 2,849 acres potentially irrigable under existing ditch facilities, making a total of 18,444 maximum irrigable acres.

WATER RIGHT DATA

The water rights that apply to the Milk River Project in Valley County are as follows:

1. Appropriation by the U.S.A. from the St. Mary River dated 5-25-1918 for 25,000 c.f.s. (Reference: Book A, Water Right Records, page 282.)

2. Appropriation by the U.S.A. from the St. Mary Reservoir dated 9-29-1921 for 25,000 c.f.s. (Reference: Book 1, Water Right Records, page 72.)

3. Appropriation by the U.S.A. from the Swift Current Creek dated 5-29-1912 for 7,500 c.f.s. (Reference: Book A, Water Right Records, page 61.)

Above water right filings are located in the Clerk and Recorder's Office, Glacier County, Montana.

Under the terms of the contract, when the Milk River Project was to be constructed nearly all of the prior appropriators of the Milk River water relinquished their water rights on the river to the United States.

4. Appropriation by Nelson Cotton from the Milk River dated 12-7-1898 for 2,500 c.f.s. (Reference: Book 6, Water Right Records, page 71.)

5. Appropriation by Nelson Cotton from the Milk River dated 7----1902 for 20 c.f.s. (Reference: Book 7, Water Right Records, page 466.)

6. Appropriation by Jurgen Johnson from the Milk River dated 4-15-1907 for 8 c.f.s. (Reference: Book 8, Water Right Records, page 30.)

7. Appropriation by Aura E. Jones from the Milk River dated 4-1-1905 for 7.5 c.f.s. (Reference: Book 7, Water Right Records, page 412.)

8. Appropriation by Samuel J. and Horatio N Kent from the Milk River dated 5-23-1908 for 10 c.f.s. (Reference: Book 8, Water Right Records, page 107.)

9. Appropriation by Emelie Lohr from the Milk River dated 3-4-1902 for 30 c.f.s. (Reference: Book 7, Water Right Records, page 26.)

10. Appropriation by George Lohr from the Milk River dated 6-30-1900 for 10 c.f.s (Reference: Book 6, Water Right Records, page 127.)

11. Appropriation by John M. Lohr from the Milk River dated 3-4-1902 for 15 c.f.s (Reference: Book 7, Water Right Records, page 25.)

12. Appropriation by Eldon E. Martin from the Milk River dated 5-7-1906 for 8 c.f.s (Reference: Book 7, Water Right Records, page 461.)

13. Appropriation by Chas. McIntyre from the Milk River dated 5-4-1898 for 2,500 c.f.s (Reference: Book 6, Water Right Records, page 60.)

14. Appropriation by Henry H. Nelson from the Milk River dated 4-2-1901 for 2,500 c.f.s (Reference: Book 6, Water Right Records, page 141.)

15. Appropriation by Fred V. Shanley from the Milk River dated 8-3-1905 for 15 c.f.s (Reference: Book 7, Water Right Records, page 407.)

16. Appropriation by Georgia F. Small from the Milk River dated 9-21-1901 for 60 c.f.s (Reference: Book 7, Water Right Records, page 10.)

17. Appropriation by Anton Waldhen from the Milk River dated 3-4-1902 for 15 c.f.s (Reference: Book 7, Water Right Records, page 24.)

18. Appropriation by M. E. Willer from the Milk River dated 9-3-1903 for 10 c.f.s (Reference: Book 7, Water Right Records, page 231.)

19. Appropriation by W. M. Woolridge from the Milk River dated 3-25-1908 for 13 c.f.s (Reference: Book 6, Miscellaneous Records, page 207.)

(See maps in Part II: Malta Irrigation District, pages 34, 35, 36, and 38; Glasgow Irrigation District, pages 9, 16, 17, 22, 23, 24, 28, 29, and 30.)

ROCK CREEK CANAL COMPANY

HISTORY

One of the first large cooperative irrigation enterprises to be started in Valley County was at Hinsdale and was known as the Rock Creek Canal. W. M. Woolridge was the first promoter of the canal and considerable difficulty was experienced in getting cooperation of the people under the canal to help in the construction of the canal system. The Rock Creek Canal Company was first incorporated on November 17, 1902, for a period of twenty years. On August 4, 1927, articles of incorporation were filed extending the company's period of corporate existence for another forty years. The last incorporation was August 17, 1967, for another forty year period. The capital stock of the corporation was listed as $48,000.00 with 60 shares of stock issued at a par value of $800.00 per share. Some of the original stockholders in the canal company were: R. R. Black, E. E. Copenhaver, J. H. Rutler, F. J. Hellstern, all of Hinsdale, and John David of Vandalia.

PRESENT STATISTICS:

Location: Lands irrigated under the Rock Creek Canal Company are in the vicinity of Hinsdale and are in Sections 3, 9, 10, 22, 23, 25-28 inclusive, and 33-36 inclusive, T. 31N - R. 36E; Sections 29-32 inclusive, T. 31N - R. 37E; Sections 1-3 inclusive, T. 30N - R. 36E; and Sections 3-6 inclusive, 9 and 10, T. 30N - R. 37E.

Length and Capacity of Canal: Point of diversion of the canal is from Rock Creek in the SE¼NW¼ Section 3, T. 31N - R. 36E. It has a length of approximately 12½ miles and an initial capacity of 200 c.f.s

Operation and Maintenance: Operation and maintenance charges are based upon the number of shares owned in the company and will vary from year to year.

Present Users: There are a total of 50½ shares of stock subscribed to in the company divided among 21 water users.

Acreage Irrigated: In 1967 there were 7,691 acres irrigated and 40 acres potentially irrigable under present ditch facilities, making a total of 7,731 acres maximum.

WATER RIGHT DATA

The water rights that are pertinent to and owned by the Rock Creek Canal Company were decreed from Rock Creek and are as follows: (1) dated 11-18-1902 for 12,000 miner's inches; (2) dated 11-18-1902 for 5,600 miner's inches. This right is subject to all the other decreed rights from Rock Creek. (Reference: Case #7945, Rock Creek Decree, Clerk of the Court's Office, Glasgow, Montana.)

(See maps in Part II: pages, 28, 31, 36, and 37.)

WATER RIGHT DATA — VALLEY COUNTY

APPROPRIATIONS AND DECREES BY STREAMS

STREAM	No. of Filings	Miner's Inches	Cu. Ft. Per Sec.	Case No.	No. of Decrees	Miner's Inches	Cu. Ft. Per Sec.
	APPROPRIATIONS (Filing Of Records)			DECREED RIGHTS			
MISSOURI RIVER BASIN							
Missouri River	23	46,500.00	1,162.50				
Spring Coulee	1	1,000.00	25.00				
Cart-Trail Coulee	1	240.00	6.00				
Timber Creek	8	2,840.00	71.00				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Black Coulee	1	---	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	2,000.00	50.00				
Square Creek	0	0	0				
Little Frenchman Coulee	1	All	---				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	2,000.00	50.00				
Frenchman Coulee	1	All	---				
N. Fork Frenchman Coulee	1	All	---				
Unnamed Coulee	1	2,000.00	50.00				
Plum Coulee	1	All	---				
Artesien Well	1	2,000.00	50.00				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	All	---				
Bone Trail Coulee	1	100.00	2.50				
Wagon Coulee	1	178.00	4.45				
Cabin Coulee	2	800.00	20.00				
Crooked Coulee	1	320.00	8.00				
Cut Coulee	1	120.00	3.00				
Sutherland Creek	3	2,214.00	55.35				
Artesien Well	1	2,000.00	50.00				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	400.00	10.00				
Unnamed Coulee	1	All	---				
Sullivan Creek	1	107.00	2.67				
Duck Creek	2	10,000.00	250.00				
Unnamed Coulee	1	2,000.00	50.00				
Middle Eight Point Coulee	1	500.00	12.50				
Unnamed Coulee	1	2,000.00	50.00				
Browning Coulee	1	200.00	5.00				
Browning Coulees	1	1,000.00	25.00				
Seventh Point Coulee	2	4,000.00	100.00				
Unnamed Coulee	1	2,000.00	50.00				
Lower Fifth Point Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	2,000.00	50.00				
Eest Coulee and all Tributaries	1	4,000.00	100.00				
Second Point Middle Coulee	1	200.00	5.00				

*Names of streams indented on the left-hand margin indicate that they are tributaries of the first stream named above which is not indented.

WATER RIGHT DATA — VALLEY COUNTY

APPROPRIATIONS AND DECREES BY STREAMS

	APPROPRIATIONS (Filing Of Records)			DECREED RIGHTS			
STREAM	**No. of Filings**	**Miner's Inches**	**Cu. Ft. Per Sec.**	**Case No.**	**No. of Decrees**	**Miner's Inches**	**Cu. Ft. Per Sec.**
Duck Creek	0	0	0				
South Fork Duck Creek	0	0	0				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
North Fork Duck Creek	1	2,000.00	50.00				
Unnamed Coulee	1	2,000.00	50.00				
Ash Coulee	1	80.00	2.00				
West Coulee and all Tributaries	1	4,000.00	100.00				
Galpin Coulee	5	7,120.00	178.00				
North Branch Galpin Coulee	1	200.00	5.00				
Unnamed Coulees	1	50.00	1.25				
Telegraph Coulee	1	1,200.00	30.00				
Stevens Coulee	1	400.00	10.00				
Bender Coulee	1	100.00	2.50				
First Coulee	1	400.00	10.00				
Milk River	47	522,536.00	13,063.40				
Frenchman Creek	3	5,680.00	142.00	4,024	1	45.00	1.13
Unnamed Coulee	1	All	---				
School Section Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Spring Coulee	1	200.00	5.00				
Rock Coulee	1	200.00	5.00	4,024	1	180.00	4.50
Brush Coulee	1	600.00	15.00	4,024	1	180.00	4.50
Three Chimney Coulee	2	---	---	4,024	1	120.00	3.00
Panhandle Coulee	3	3,300.00	82.50				
Weters of West Coulee	1	600.00	15.00				
Swanson Coulee	2	760.00	19.00				
Schneider Coulee	1	---	---				
Frenchman Ditch (Waste Water)	1	1,296.00	32.40				
Drabbs Coulee	1	800.00	15.00				
Miles Crossing (Big) Coulee	2	4,000.00	100.00				
Hansen Coulee	0	0	0				
Lake Coulee	1	1,000.00	25.00				
Narrill Coulee	1	3,000.00	75.00				
Beaver Creek	8	99,140.00	2,478.50	168	1	800.00	20.00
Larb Creek	10	92,300.00	2,307.50				
Unnamed Coulee	1	2,000.00	50.00				
Craig Coulee	1	4,000.00	100.00				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	2	4,000.00	100.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	2,000.00	50.00				
Corral Coulee	2	2,400.00	60.00				
Grant Coulee	0	0	0				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	0	0	0				

WATER RIGHT DATA — VALLEY COUNTY

APPROPRIATIONS AND DECREES BY STREAMS

STREAM	APPROPRIATIONS (Filing Of Records) No. of Filings	Miner's Inches	Cu. Ft. Per Sec.	DECREED RIGHTS Case No.	No. of Decrees	Miner's Inches	Cu. Ft. Per Sec.
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	---	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	2,000.00	50.00				
Coal Bank Coulee	2	1,000.00	25.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Frank Kern Coulee	1	2,000.00	50.00				
Coon Coulee	1	All	---				
Square Cr. (Coulee)	3	1,200.00	30.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Powell Coulee	1	600.00	15.00				
Abel Coulee	1	All	---				
Mc Nab Creek (Ash Coulee)	3	16,600.00	415.00				
North Fork Mc Nab Creek	1	600.00	15.00				
Middle Fork Mc Nab Creek	1	600.00	15.00				
First Creek	1	600.00	15.00				
Total Lerb Creek and Tributaries	**57**	**149,900.00**	**3,747.50**				
Slough Spring	1	1,500.00	37.50				
Muskrat Slough	1	288.00	7.20				
Horse Coulee	1	4,000.00	100.00				
Alkali Coulee	1	4,000.00	100.00				
Rock Coulee	1	3,000.00	75.00				
Big Jaw Coulee	1	4,000.00	100.00				
Cow Canyon	1	3,000.00	75.00				
Big Horn Coulee	2	10,000.00	250.00				
Little Horn Coulee	2	10,000.00	250.00				
Lump Jaw Coulee	2	10,000.00	250.00				
Big Jaw Coulee	2	10,000.00	250.00				
Total Beever Creek and Tributaries	**80**	**308,828.00**	**7,720.70**		**1**	**800.00**	**20.00**
Rock Creek	**46**	**665,380.00**	**16,634.50**	**7,945**	**1**	**18,680.00**	**467.00**
Unnamed Coulee	1	All	---				
Line Coulee	1	600.00	15.00				
Horse Creek	2	1,600.00	40.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	1,200.00	30.00				

WATER RIGHT DATA — VALLEY COUNTY

APPROPRIATIONS AND DECREES BY STREAMS

STREAM	APPROPRIATIONS (Filing Of Records) No. of Filings	Miner's Inches	Cu. Ft. Per Sec.	DECREED RIGHTS Case No.	No. of Decrees	Miner's Inches	Cu. Ft. Per Sec.
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
South Creek	1	2,000.00	50.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Tomato Creek	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
First Coulee	2	600.00	15.00				
Chambers Coulee	2	2,000.00	50.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Mc Eachran Creek	2	600.00	15.00				
First Big Coulee	1	400.00	10.00				
No Name Coulee (Second Big Coulee)	2	600.00	15.00				
Davison Coulee	3	200.00	5.00				
Unnamed Coulee	1	All	---				
Bluff Creek	2	1,828.00	45.70				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
West Fork Bluff Creek	2	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Dry Coulee	1	300.00	7.50				
Ichpair Creek (Coulee)	4	7,100.00	177.50				
Upper Ichpair Creek	1	3,000.00	75.00				
Unnamed Coulee	1	All	---				
Riggin Coulee	2	2,000.00	50.00				
Harry Coulee	2	360.00	9.00				
Unnamed Coulee	1	All	---				
Crow Creek	3	23,200.00	580.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	2	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
East Fork Crow Creek	0	0	0				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				

WATER RIGHT DATA — VALLEY COUNTY

APPROPRIATIONS AND DECREES BY STREAMS

STREAM	APPROPRIATIONS (Filing Of Records) No. of Filings	Miner's Inches	Cu. Ft. Per Sec.	DECREED RIGHTS Case No.	No. of Decrees	Miner's Inches	Cu. Ft. Per Sec.
Unnamed Coulee	1	All	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Barr Coulee	1	---	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Big Sage (Olmes) Creek	1	12,000.00	300.00				
Unnamed Coulee	1	All	---				
Snake Creek	2	864.00	21.60				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Little Snake Creek	1	600.00	15.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Snake Creek Coulee (Jack Creek)	3	700.00	17.50				
East Fork (Jordan) Coulee	1	160.00	4.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Badland Coulee	1	120.00	3.00				
Boggy Coulee	1	320.00	8.00				
Buck Brush Coulee	1	---	---				
Bull Pasture Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Willow Creek	5	15,560.00	389.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
East Fork Willow Creek	0	0	0				

WATER RIGHT DATA — VALLEY COUNTY

APPROPRIATIONS AND DECREES BY STREAMS

STREAM	APPROPRIATIONS (Filing Of Records) No. of Filings	Miner's Inches	Cu. Ft. Per Sec.	DECREED RIGHTS Case No.	No. of Decrees	Miner's Inches	Cu. Ft. Per Sec.
Unnamed Coulee	1	All	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Tributary	2	3,000.00	75.00				
Unnamed Coulee	2	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Badland Coulee	2	664.00	16.60				
Bitter Creek	0	0	0				
Long Coulee	1	500.00	12.50				
Unnamed Coulee	1	All	---				
Basin Coulee	1	500.00	12.50				
Frazier Coulee	1	400.00	10.00				
South Fork Bitter Creek	0	0	0				
Unnamed Coulee	1	All	---				
Burnett Coulee	1	1,000.00	25.00				
Collins Creek	2	760.00	19.00				
Hogback Coulee	2	600.00	15.00				
Eagles Nest Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Ash Coulee	1	600.00	15.00				
Horse Coulee	1	400.00	10.00				
Unnamed Coulee	1	All	---				
Short Coulee	1	400.00	10.00				
Coyote Coulee	1	320.00	8.00				
Spring Coulee	1	600.00	15.00				
Total Willow Creek and Tributaries	**47**	**25,304.00**	**632.60**				
Unnamed Coulee	0	0	0				
White Spring	1	50.00	1.25				
Papoose Creek	1	4,000.00	100.00				
Unnamed Coulee	1	All	---				
Little Papoose Creek	0	0	0				
Unnamed Coulee	1	All	---				

WATER RIGHT DATA — VALLEY COUNTY

APPROPRIATIONS AND DECREES BY STREAMS

STREAM	APPROPRIATIONS (Filing Of Records) No. of Filings	Miner's Inches	Cu. Ft. Per Sec.	DECREED RIGHTS Case No.	No. of Decrees	Miner's Inches	Cu. Ft. Per Sec.
Hay Coulee	1	200.00	5.00				
Big Springs	1	120.00	3.00				
South Springs	1	100.00	2.50				
High Hill Coulee	1	14,000.00	350.00				
Cash Creek	6	2,780.00	69.50				
Turnip Creek	1	400.00	10.00				
Big (Bell) Coulee	1	600.00	15.00				
Middle Fork Cash Creek	2	1,400.00	35.00				
East Fork Cash Creek	3	3,400.00	85.00				
Brush Coulee	2	40.00	1.00				
White Bread Coulee	3	1,560.00	39.00				
Unnamed Coulees	1	800.00	20.00				
Halbert Coulee	1	4,000.00	100.00				
Snake Coulee	1	320.00	8.00				
Total Rock Creek and Tributaries	**230**	**786,806.00**	**19,670.15**		**1**	**18,680.00**	**467.00**
Tank (Buffalo) Coulee	1	500.00	12.50				
Big Coulee Number 1	2	10,000.00	250.00				
Big Coulee Number 2	2	12,000.00	300.00				
Middle Coulee	1	2,000.00	50.00				
Kent Coulee	1	4,000.00	100.00				
Ash Coulee	3	80,240.00	2,006.00				
Culvert Coulee	1	320.00	8.00				
West Fork Ash Coulee	2	400.00	10.00				
Bear Creek	4	10,800.00	270.00				
Mapes Coulee	1	120.00	3.00				
Brush Fork of Bear Creek (Brush Coulee)	2	520.00	13.00				
Black Coulee	2	520.00	13.00				
Alkali Creek	2	600.00	15.00				
Hall Coulee (West Fork of Bear Creek)	0	0	0				
Unnamed Coulee	1	All	---				
Lime Creek	7	13,440.00	336.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	2	All	---				
Black Tail Coulee	2	1,000.00	25.00				
Unnamed Coulee	1	All	---				
Rabbit Coulee	1	400.00	10.00				
Long Coulee	1	144.00	3.60				
Lake Bed Coulee	1	400.00	10.00				
Lund Coulee	1	4,000.00	100.00				
Fork Coulee	1	144.00	3.60				
Total Bear Creek and Tributaries	**30**	**32,088.00**	**802.20**				
Hay Coulee	10	96,900.00	2,422.50				
Buffalo Coulee	4	85,880.00	2,147.00				
Alkali Creek	1	0	0				
Total Hay Coulee and Tributaries	**15**	**182,780.00**	**4,569.50**				
Spring Coulee	1	400.00	10.00				
Buggy Creek	17	9,770.00	244.25				

WATER RIGHT DATA — VALLEY COUNTY

APPROPRIATIONS AND DECREES BY STREAMS

STREAM	APPROPRIATIONS (Filing Of Records) No. of Filings	Miner's Inches	Cu. Ft. Per Sec.	DECREED RIGHTS Case No.	No. of Decrees	Miner's Inches	Cu. Ft. Per Sec.
Unnamed Coulee	1	All	---				
East Branch Buggy Creek	2	1,600.00	40.00				
Wire Grass Coulee	1	200.00	5.00				
West Fork Buggy Creek	1	120.00	3.00				
Canyon Creek	1	320.00	8.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Crooked Creek	1	320.00	8.00				
Unnamed Coulee	1	400.00	10.00				
Unnamed Coulee	1	240.00	6.00				
Spring Creek (Big Spring, Little Spring Coulee)	8	6,960.00	174.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unger Coulee	0	0	0				
West Fork Unger Coulee	1	1,200.00	30.00				
Gravel Coulee	1	600.00	15.00				
Total Buggy Creek end Tributaries	**40**	**21,730.00**	**543.25**				
Antelope Creek	2	400.00	10.00				
Unnamed Coulee	1	All	---				
Antelope Spring	1	200.00	5.00				
Old Tampico Coulee	1	400.00	10.00				
Brown Coulee	1	1,000.00	25.00				
Chapman (Dry) Coulee	2	8,400.00	210.00				
Antelopa (Dry Run) (Dry) Creek	10	91,120.00	2,278.00				
West Fork Dry Run (N. FK. Antelope) (Dry Run) Creek	2	1,000.00	25.00				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Mc Gregor (Dry Run) Coulee	1	1,000.00	25.00				
Smiley Coulee	1	750.00	18.75				
Lone Tree Coulee	1	232.00	5.80				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
North Fork Antelope Creek	0	0	0				
Traux (North Branch Dry Run) (Moose) Coulee	5	7,160.00	179.00				
Abel Coulee	1	400.00	10.00				
Snow Coulee	1	200.00	5.00				
South Fork Traux Coulee	2	400.00	10.00				
Mott Coulee	1	600.00	15.00				

WATER RIGHT DATA — VALLEY COUNTY

APPROPRIATIONS AND DECREES BY STREAMS

STREAM	APPROPRIATIONS (Filing Of Records) No. of Filings	Miner's Inches	Cu. Ft. Per Sec.	DECREED RIGHTS Case No.	No. of Decrees	Miner's Inches	Cu. Ft. Per Sec.
Dutch Coulee	1	240.00	6.00				
Hardscrabble Creek	1	1,300.00	32.50				
Cabin Coulee	1	400.00	10.00				
Bog Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulees	1	600.00	15.00				
Total Antelope Creek and Tributaries	**50**	**122,042.00**	**3,051.05**				
Mooney Coulee (Creek)	2	600.00	15.00				
Richardson Coulee	1	1,000.00	25.00				
Squaw Crossing Creek	1	400.00	10.00				
Rock Coulee	1	400.00	10.00				
Brazil (Palmira) Creek	8	88,640.00	2,216.00				
North Fork Brazil Creek	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Alousi Coulee	1	320.00	8.00				
Unnamed Coulee	2	All	---				
Tixan Coulee	1	200.00	5.00				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Alkali Coulee	1	2,000.00	50.00				
Miller Coulee	1	4,000.00	100.00				
Teofiel Coulee	1	400.00	10.00				
Little Brazil (East Branch Brazil) Creek (Lindeton)	2	8,400.00	210.00				
Poole Coulee	1	---	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	720.00	18.00				
West Fork Brazil Creek	2	800.00	20.00				
No Name Creek	1	40.00	1.00				
Total Brazil Creek and Tributaries	**27**	**105,520.00**	**2,638.00**				
Cherry Creek	15	14,912.00	372.80				
West Fork Cherry Creek	1	600.00	15.00				
Unnamed Coulee	1	All	---				
School Section Creek	2	800.00	20.00				
East Fork Cherry Creek	1	160.00	4.00				
Hawk Coulee	1	1,200.00	30.00				
Harley (Spring) (Mooney) Coulee	7	3,620.00	90.50				
Foss Coulee	1	600.00	15.00				
Unnamed Coulee	1	240.00	6.00				
Martin Coulee	3	240.00	6.00				
Ditch Coulee	1	320.00	8.00				
Kampfer Coulee	1	320.00	8.00				
Total Cherry Creek and Tributaries	**35**	**23,012.00**	**575.30**				
Willow Creek	14	109,748.00	2,743.65				
South Fork Willow							

WATER RIGHT DATA — VALLEY COUNTY

APPROPRIATIONS AND DECREES BY STREAMS

STREAM	APPROPRIATIONS (Filing Of Records) No. of Filings	Miner's Inches	Cu. Ft. Per Sec.	DECREED RIGHTS Case No.	No. of Decrees	Miner's Inches	Cu. Ft. Per Sec.
Creek	2	200.00	5.00				
North Fork Willow Creek	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Hard Pan Creek	1	All	---				
Unnamed Coulee	1	All	---				
Corral Coulee	3	All	---				
Unnamed Coulee	1	All	---				
Short Coulee	1	All	---				
Unnamed Coulee	1	12,960.00	324.00				
Unnamed Coulee	1	7,840.00	196.00				
Unnamed Coulee	1	5,840.00	146.00				
Unnamed Coulee	1	10,600.00	265.00				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	4,000.00	100.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	2,000.00	50.00				
Lone Tree Creek	4	2,800.00	70.00				
Middle Fork Lone Tree Creek	2	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
North Fork Lone Tree Creek	4	2,200.00	55.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	3	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	2,000.00	50.00				
South Fork Lone Tree Creek	3	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	2	All	---				
Unnamed Coulee	2	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				

WATER RIGHT DATA — VALLEY COUNTY

APPROPRIATIONS AND DECREES BY STREAMS

STREAM	APPROPRIATIONS (Filing Of Records) No. of Filings	Miner's Inches	Cu. Ft. Per Sec.	DECREED RIGHTS Case No.	No. of Decrees	Miner's Inches	Cu. Ft. Per Sec.
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	2	6,800.00	170.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Dead Horse Coulee	1	4,400.00	110.00				
Unnamed Coulee	1	7,200.00	180.00				
Unnamed Coulee	1	2,000.00	50.00				
Second North Fork Lone Tree Creek	4	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	All	---				
Total Lone Tree Creek and Tributaries	**61**	**33,400.00**	**835.00**				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Bomber Creek	0	0	0				
Unnamed Coulee	1	All	---				
Pearson Coulee	1	All	---				
Unnamed Coulee	1	---	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	2	All	---				
Unnamed Coulee	1	All	---				
Dog Creek	3	172,080.00	4,302.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	2	2,000.00	50.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Mud (Muddy) Creek	3	2,500.00	62.50				
Wilderness Coulee	0	0	0				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	All	---				
Little Beaver (Beaver) Creek	4	720.00	18.00				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				

WATER RIGHT DATA — VALLEY COUNTY

APPROPRIATIONS AND DECREES BY STREAMS

STREAM	APPROPRIATIONS (Filing Of Records) No. of Filings	Miner's Inches	Cu. Ft. Per Sec.	DECREED RIGHTS Case No.	No. of Decrees	Miner's Inches	Cu. Ft. Per Sec.
North Fork Little Beaver Creek	0	0	0				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	2,600.00	65.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	2,000.00	50.00				
South Fork Little Beaver Creek	0	0	0				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	All	---				
Miller Coulee	3	6,560.00	164.00				
Unnamed Coulee	0	0	0				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	2	6,400.00	160.00				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	All	---				
Total Little Beaver Creek and Tributaries	**32**	**36,280.00**	**907.00**				
Coyote Creek	2	7,680.00	192.00				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	2,000.00	50.00				
Sage Hen Creek	2	22,400.00	560.00				
East Fork Sage Hen Creek	1	2,000.00	50.00				
Unnamed Coulee	1	4,400.00	110.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	2,000.00	50.00				
Mud Creek	1	All	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	2,000.00	50.00				
Unnamed Coulee	2	All	---				
Unnamed Coulee	1	4,000.00	100.00				
Unnamed Coulee	2	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	0	0	0				

WATER RIGHT DATA — VALLEY COUNTY

APPROPRIATIONS AND DECREES BY STREAMS

STREAM	APPROPRIATIONS (Filing Of Records) No. of Filings	Miner's Inches	Cu. Ft. Per Sec.	DECREED RIGHTS Case No.	No. of Decrees	Miner's Inches	Cu. Ft. Per Sec.
Unnamed Coulee	1	All	---				
School Section Coulee	1	80.00	2.00				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Butte Coulee	1	320.00	8.00				
Cottonwood Coulee	2	200.00	5.00				
Long Coulee	1	320.00	8.00				
Hosford Coulee	1	All	---				
Total Willow Creek and Tributaries	**189**	**458,846.00**	**11,471.15**				
Lenz's Coulee	1	400.00	10.00				
Burke Coulee and Spring	1	400.00	10.00				
Dog (Dogy) (Doga) Creek	4	11,000.00	275.00				
Long Lake	2	3,600.00	90.00				
Peterman Coulee	1	600.00	15.00				
Whatley (Spring) Coulee.	3	900.00	22.50				
Butch Coulee	1	400.00	10.00				
Buch Coulee	1	640.00	16.00				
Unnamed Coulee	1	200.00	5.00				
Whatley (Keller) Springs	1	All	---				
Frenchman (Lindeke) Coulee	2	836.00	20.90				
School Section (Spring) Coulee	1	600.00	15.00				
Sterback Coulee	1	400.00	10.00				
Nashua Springs	1	480.00	12.00				
Lenz's Coulee	1	600.00	15.00				
Road Coulee	1	800.00	20.00				
Porcupine Creek	7	82,016.00	2,050.40				
Middle Fork Porcupine Creek	0	0	0				
Unnamed Coulees	1	1,800.00	45.00				
Snow Coulee (West Fork Snow Coulee)	3	13,000.00	325.00				
Unnamed Coulee	1	1,200.00	30.00				
North Fork Snow (Bog) Coulee	1	200.00	5.00				
East Fork Snow Coulee	2	48,200.00	1,205.00				
Springs	1	400.00	10.00				
Unnamed Coulee	0	0	0				
Well and Bog	1	50.00	1.25				
West Fork Porcupine Creek	0	0	0				
Unnamed Coulee	1	All	---				
Unnamed Coulee	0	0	0				
Unnamed Coulee	1	All	---				
Dry Fork	1	600.00	15.00				
Dry Run Coulee	1	400.00	10.00				
Spring	2	400.00	10.00				
No Name Coulee	2	800.00	20.00				
East Fork Porcupine Creek	1	200.00	5.00				

WATER RIGHT DATA — VALLEY COUNTY

APPROPRIATIONS AND DECREES BY STREAMS

STREAM	APPROPRIATIONS (Filing Of Records) No. of Filings	Miner's Inches	Cu. Ft. Per Sec.	DECREED RIGHTS Case No.	No. of Decrees	Miner's Inches	Cu. Ft. Per Sec.
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Unnamed Coulee	1	All	---				
Chokecherry Coulee	1	200.00	5.00				
Total Porcupine Creek and Tributaries	**31**	**149,466.00**	**3,736.65**				
E. S. Coulee	2	1,040.00	26.00				
Total Milk River and Tributaries	**840**	**2,870,046.00**	**71,751.15**		**3**	**20,005.00**	**500.13**
Little Porcupine Creek	4	60,400.00	1,510.00				
Charley Creek	0	0	0				
Kintyre Creek	0	0	0				
Unnamed Coulee	1	22.00	.55				
Waste Water	1	All	---				
Wolf Creek	0	0	0				
West Fork Wolf Creek	2	2,000.00	50.00				
Thiessen Coulee	1	---	---				
Poplar River	0	0	0				
West Fork Poplar River	0	0	0				
Spring Coulee	0	0	0				
Unnamed Coulee	1	33.00	.82				
Roanwood Coulee	0	0	0				
Hamilton Coulee	1	400.00	10.00				
Spring Brook Coulee	1	480.00	12.00				
Cottonwood Creek	2	600.00	15.00				
Grand Total Missouri River and Tributaries	**953**	**20,057,650.00**	**501,441.24**		**3**	**20,005.00**	**500.13**
GRAND TOTAL FOR VALLEY COUNTY	**953**	**20,057,650.00**	**501,441.24**		**3**	**20,005.00**	**500.13**

DRAINAGES IN VALLEY COUNTY NOT LOCATED

STREAM	No. of Filings	Miner's Inches	Cu. Ft. Per Sec.
Lone Tree Coulee	1	600.00	15.00
Norweigian Coulee	1	500.00	12.50
Sheep Camp Coulee	1	1,000.00	25.00
Sheep Shed Coulee	1	4,000.00	100.00
Willow Creek	1	1,000.00	25.00
Prentice Lake	1	200.00	5.00
TOTALS	**6**	**7,300.00**	**182.50**

WATER RESOURCES SURVEY

Valley County, Montana

PART II

Maps Showing Irrigated Areas in Colors

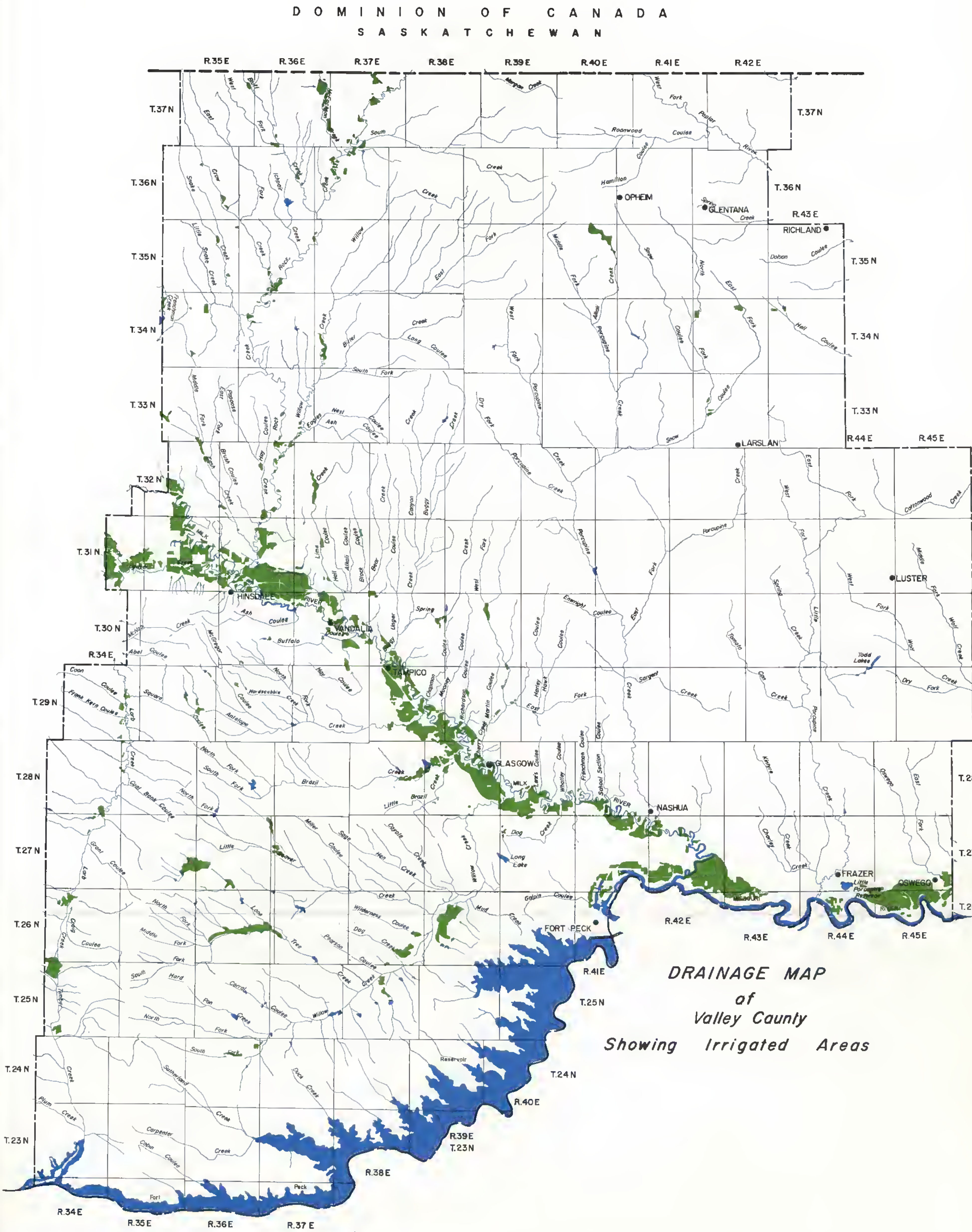
Designating the Sources of Supply

Published by

MONTANA WATER RESOURCES BOARD

Helena, Montana

June, 1968


DOMINION OF CANADA
SASKATCHEWAN
DRAINAGE MAP
of
Valley County
Showing Irrigated Areas
R.35E
R.36E
R.37E
R.38E
R.39E
R.40E
R.41E
R.42E
R.43E
R.44E
R.45E
R.34E
T.37N
T.36N
T.35N
T.34N
T.33N
T.32N
T.31N
T.30N
T.29N
T.28N
T.27N
T.26N
T.25N
T.24N
T.23N
OPHEIM
GLENTANA
RICHLAND
LARSLAN
LUSTER
HINSDALE
VANDALIA
TAMPICO
GLASGOW
NASHUA
FORT PECK
FRAZER
OSWEGO
MILK RIVER
Fort Peck Reservoir

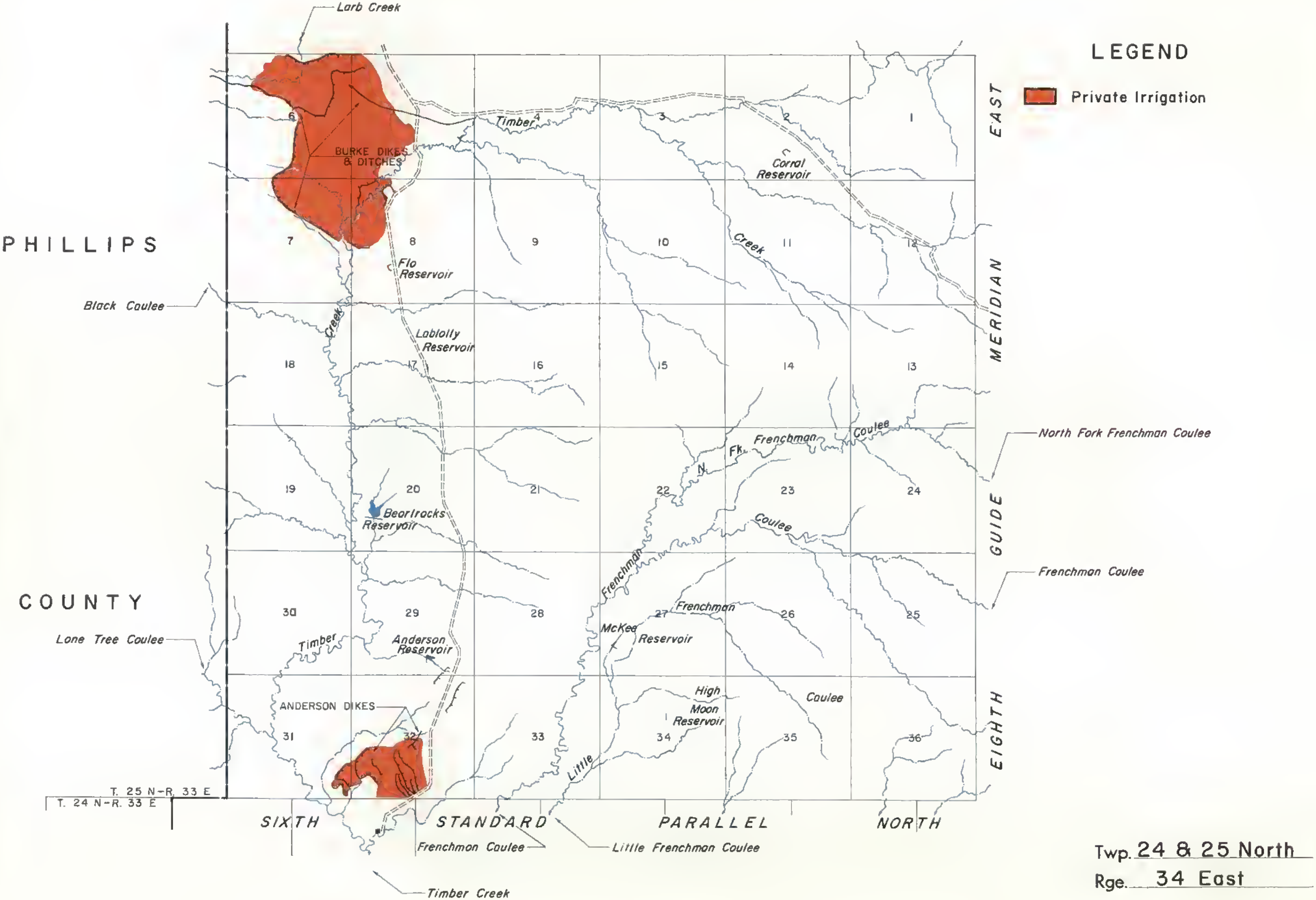
MAP SYMBOL INDEX

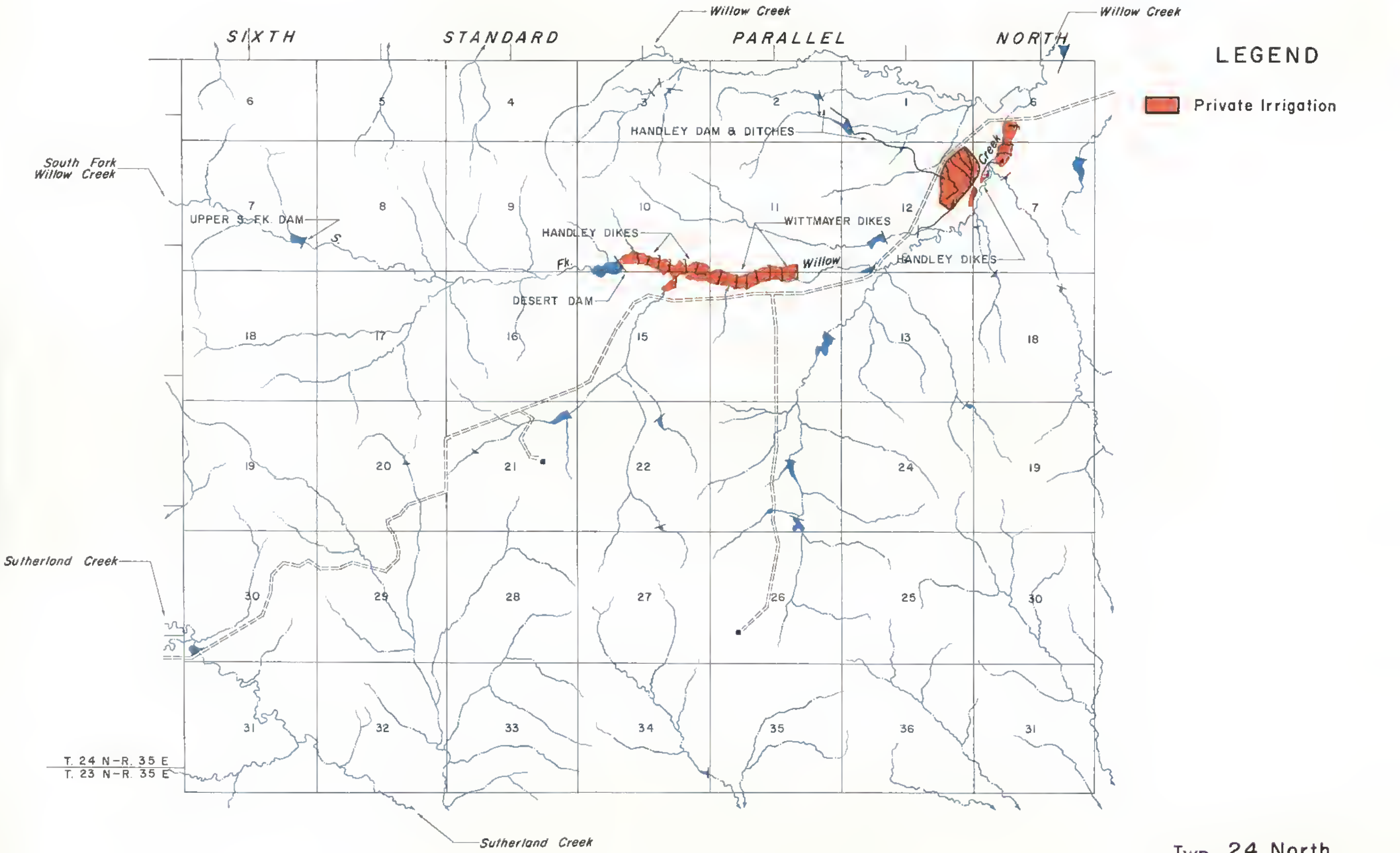
BOUNDARIES	TRANSPORTATION
COUNTY LINE	PAVED ROADS
NATIONAL FOREST LINE	UNPAVED ROADS

DITCHES	
CANALS OR DITCHES	RAILROADS
DRAIN DITCHES	STATE HIGHWAY
PROPOSED DITCHES	U.S. HIGHWAY
	AIRPORT

STRUCTURES & UNITS

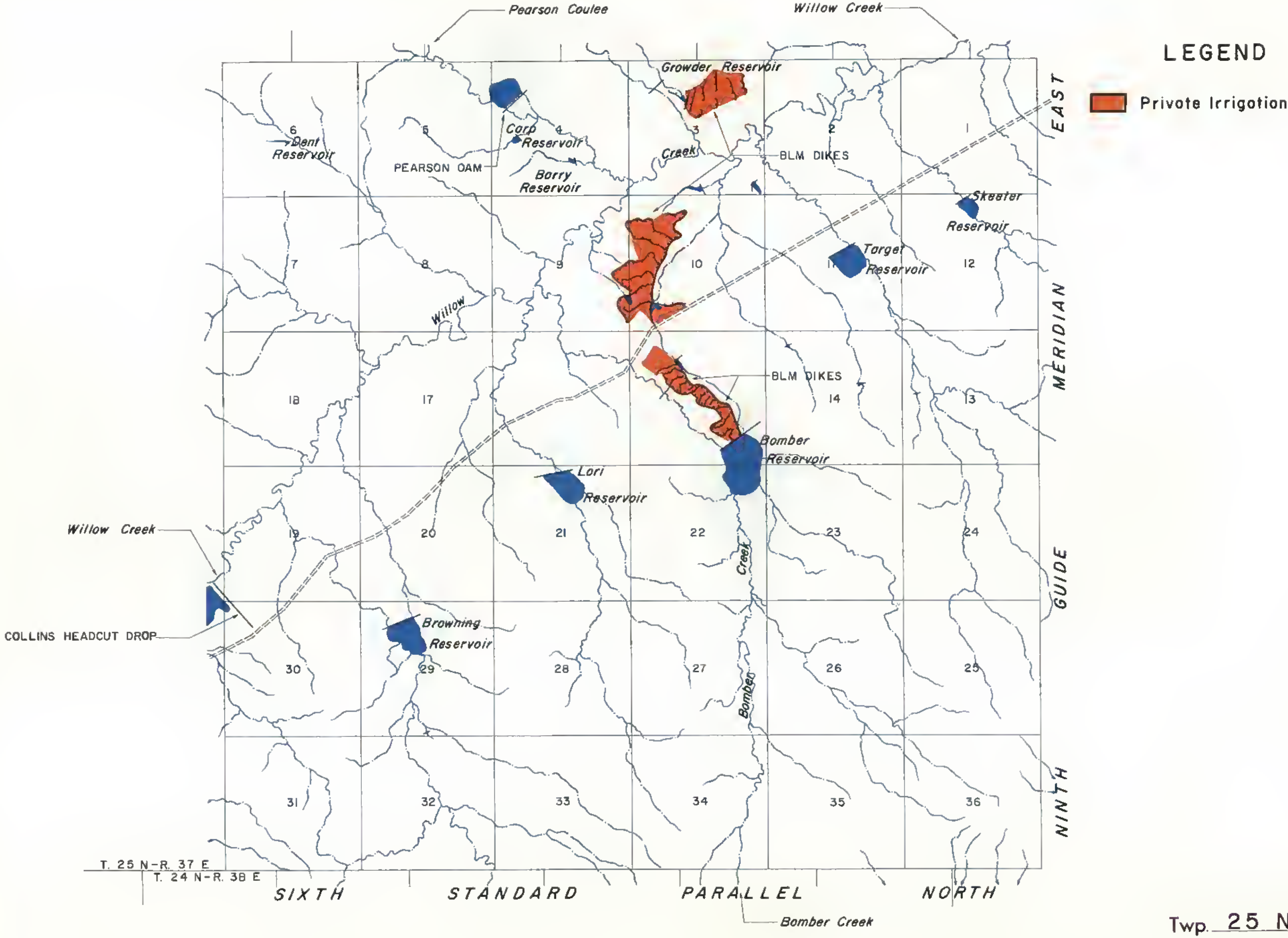
DAM	SPRING
DIKE	SWAMP
FLUME	GAUGING STATION
SIPHON	POWER PLANT
SPILL	STORAGE TANK
SPRINKLER SYSTEM	CEMETERY
WEIR	FAIRGROUND
PIPE LINE	FARM OR RANCH UNIT
PUMP	LOOKOUT STATION
PUMP SITE	RANGER STATION
RESERVOIR	RAILROAD TUNNEL
WELL	SCHOOL
NATURAL CARRIER USED AS DITCH	SHAFT, MINE, OR DRIFT


LEGEND
Private Irrigation
Larb Creek
PHILLIPS
COUNTY
Black Coulee
Lone Tree Coulee
BURKE DIKES & DITCHES
Timber
Corral Reservoir
Creek
Flo Reservoir
Creek
Loblolly Reservoir
N. Fk. Frenchman Coulee
Bearlrocks Reservoir
Coulee
Frenchman
Frenchman
McKee Reservoir
Timber
Anderson Reservoir
ANDERSON DIKES
High Moon Reservoir
Coulee
Little
North Fork Frenchman Coulee
Frenchman Coulee
EAST MERIDIAN GUIDE EIGHTH
SIXTH STANDARD PARALLEL NORTH
T. 25 N-R. 33 E
T. 24 N-R. 33 E
Frenchman Coulee
Little Frenchman Coulee
Timber Creek
6
5
4
3
2
1
7
8
9
10
11
12
18
17
16
15
14
13
19
20
21
22
23
24
30
29
28
27
26
25
31
32
33
34
35
36
Twp. 24 & 25 North
Rge. 34 East



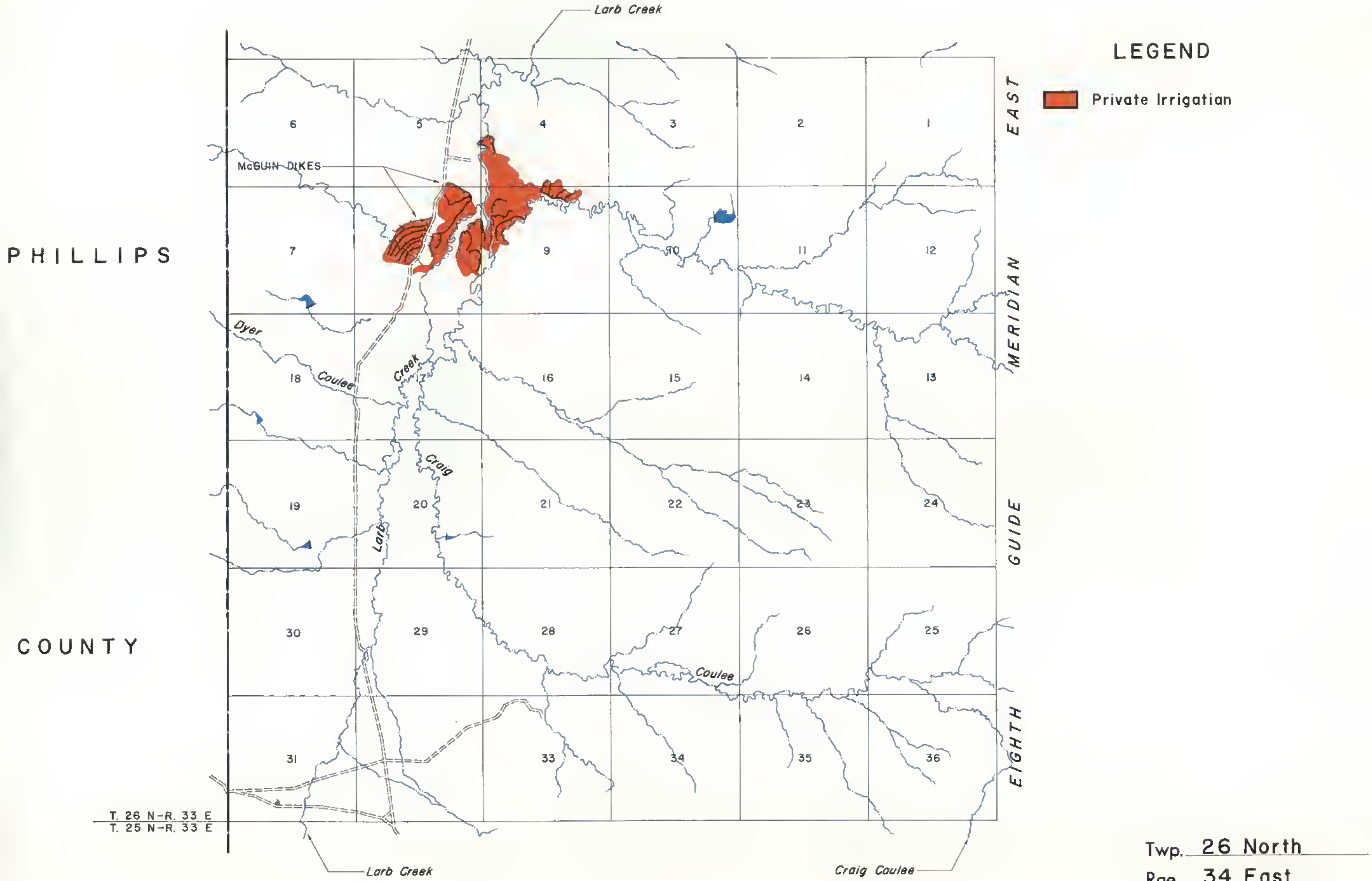
Twp. 24 North

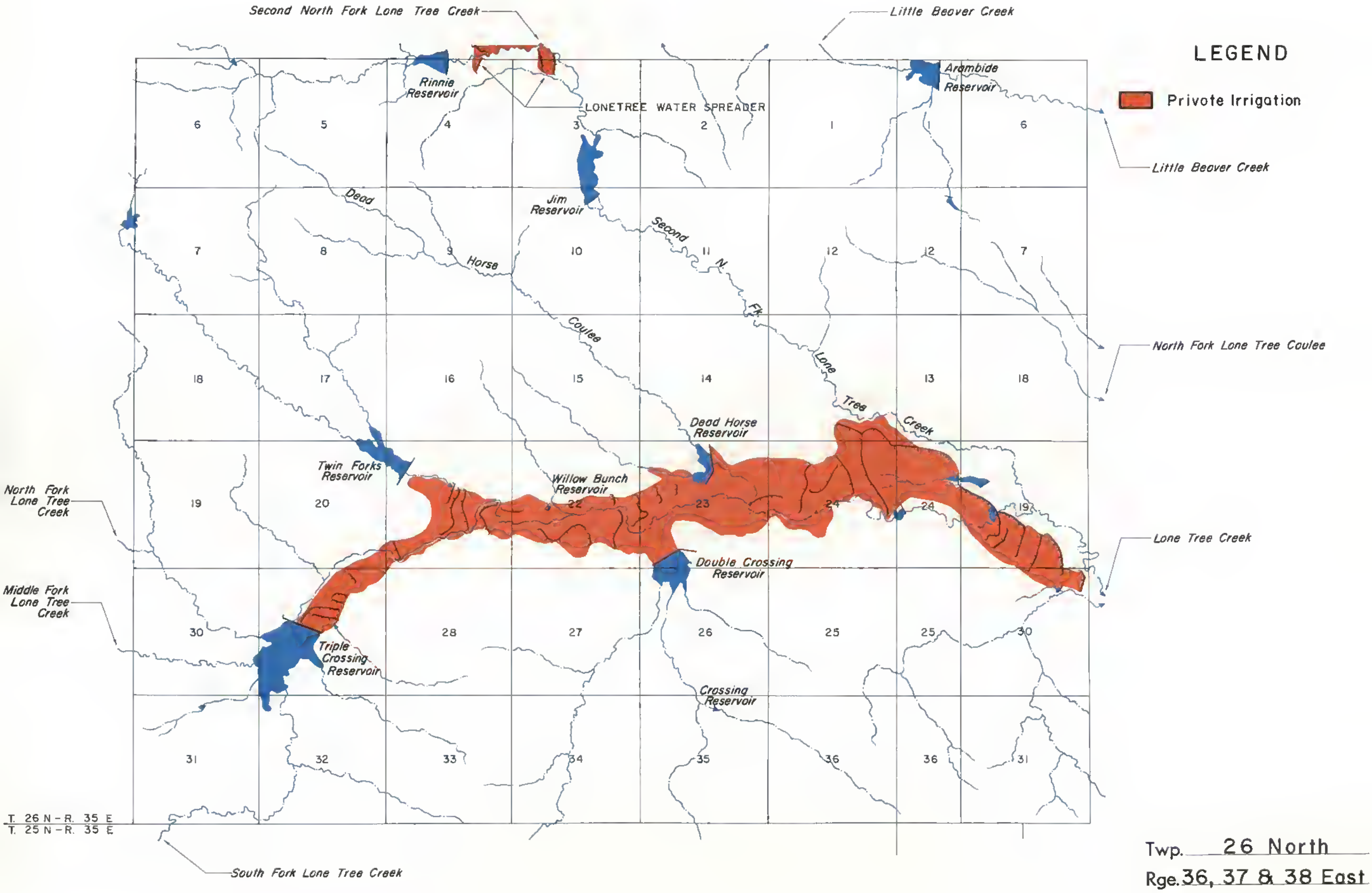
Rge. 35 & 36 East

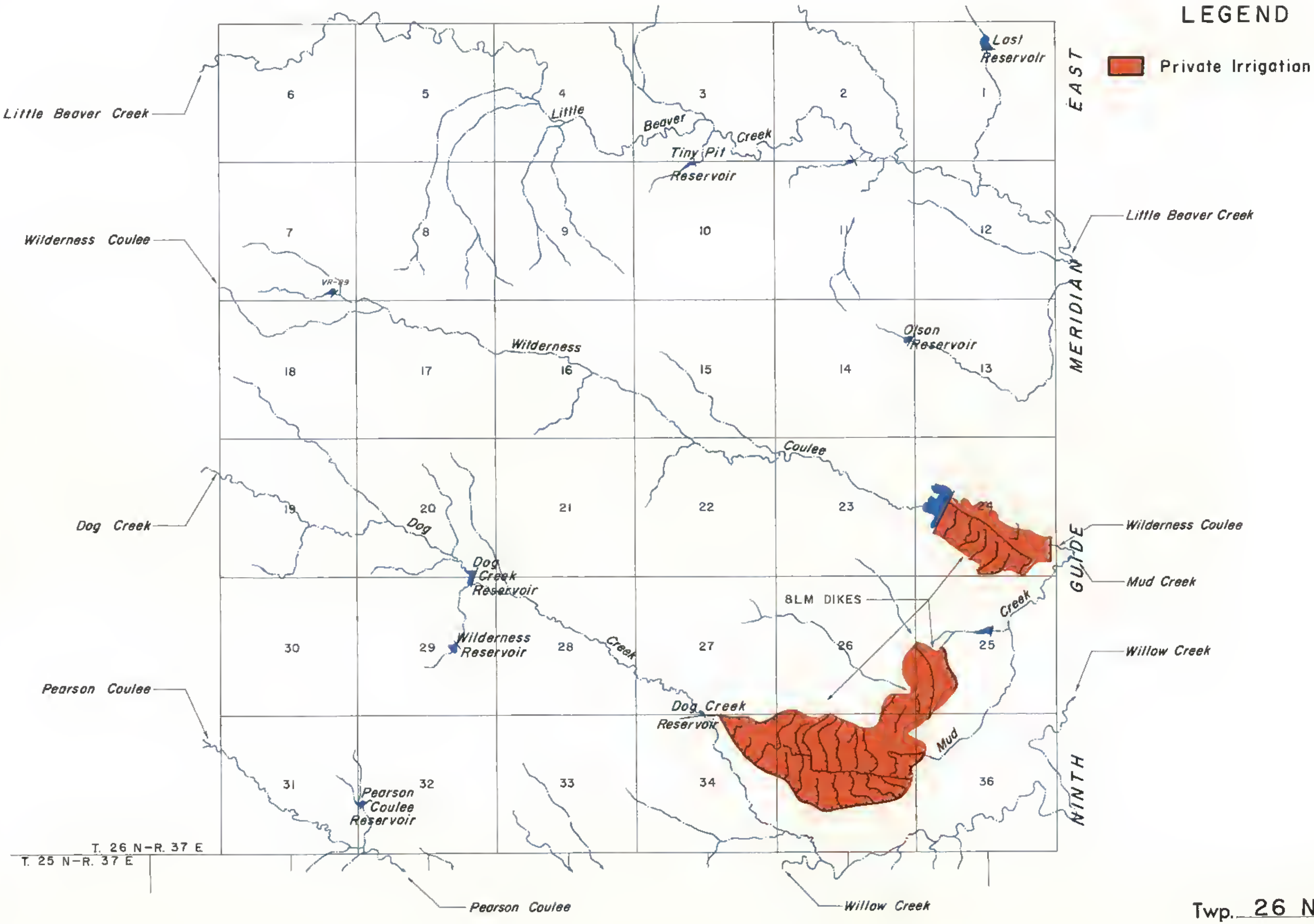


Twp. 25 North

Rge. 38 East

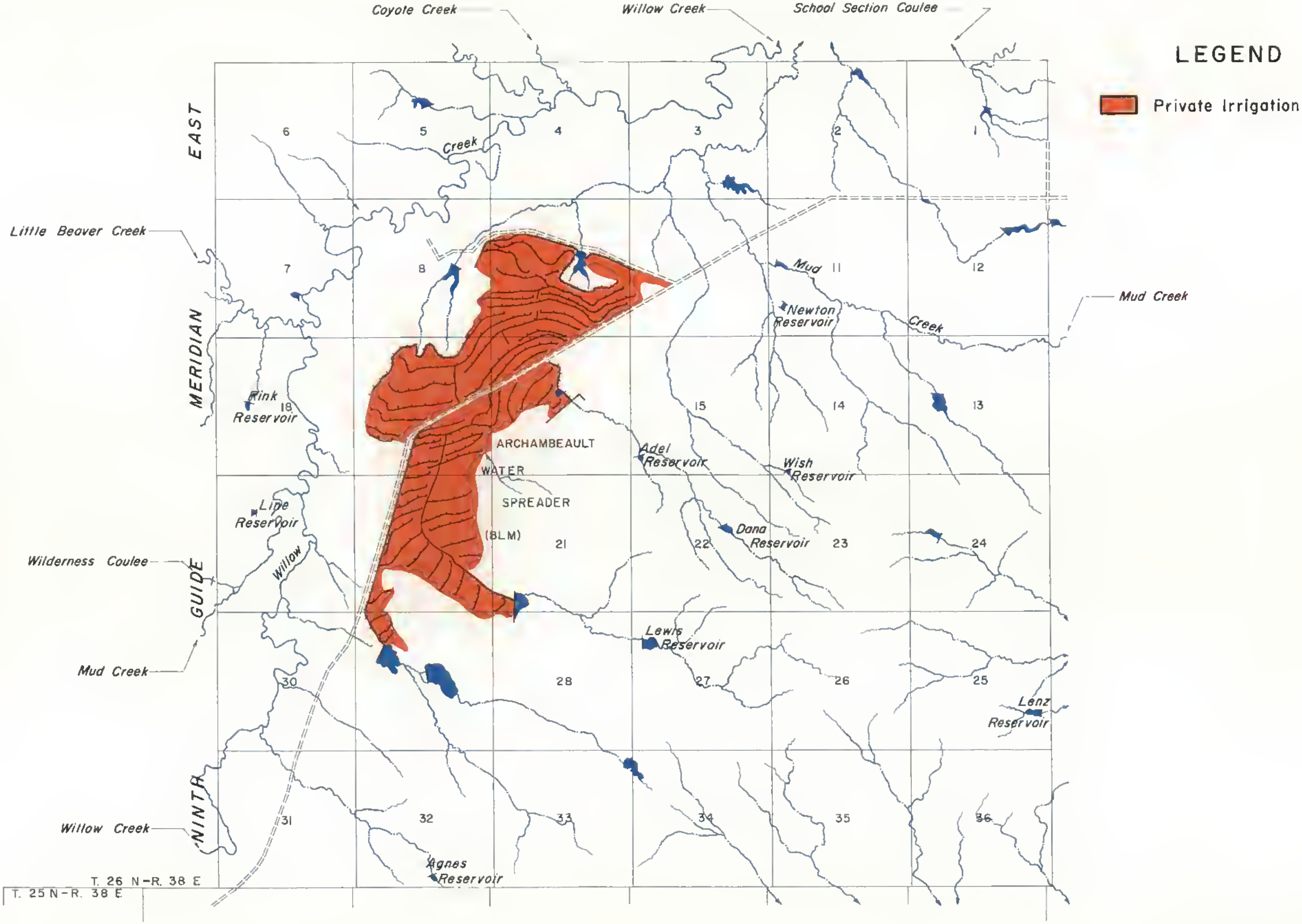

Larb Creek
LEGEND
Private Irrigation
EAST MERIDIAN
GUIDE
EIGHTH
PHILLIPS
COUNTY
McGUIN DIKES
6
5
4
3
2
1
7
9
10
11
12
Dyer
Coulee
Creek
18
17
16
15
14
13
Craig
19
20
21
22
23
24
Larb
30
29
28
27
26
25
Coulee
31
33
34
35
36
T. 26 N-R. 33 E
T. 25 N-R. 33 E
Larb Creek
Craig Coulee
Twp. 26 North
Rge. 34 East


LEGEND
Privote Irrigation
Second North Fork Lone Tree Creek
Little Beover Creek
Rinnie Reservoir
LONETREE WATER SPREADER
Arambide Reservoir
Little Beover Creek
Jim Reservoir
Dead Horse Coulee
Second N. Fk. Lone Tree Creek
North Fork Lone Tree Coulee
Dead Horse Reservoir
Twin Forks Reservoir
Willow Bunch Reservoir
North Fork Lone Tree Creek
Lone Tree Creek
Double Crossing Reservoir
Middle Fork Lone Tree Creek
Triple Crossing Reservoir
Crossing Reservoir
T. 26 N - R. 35 E
T. 25 N - R. 35 E
South Fork Lone Tree Creek
Twp. 26 North
Rge. 36, 37 & 38 East



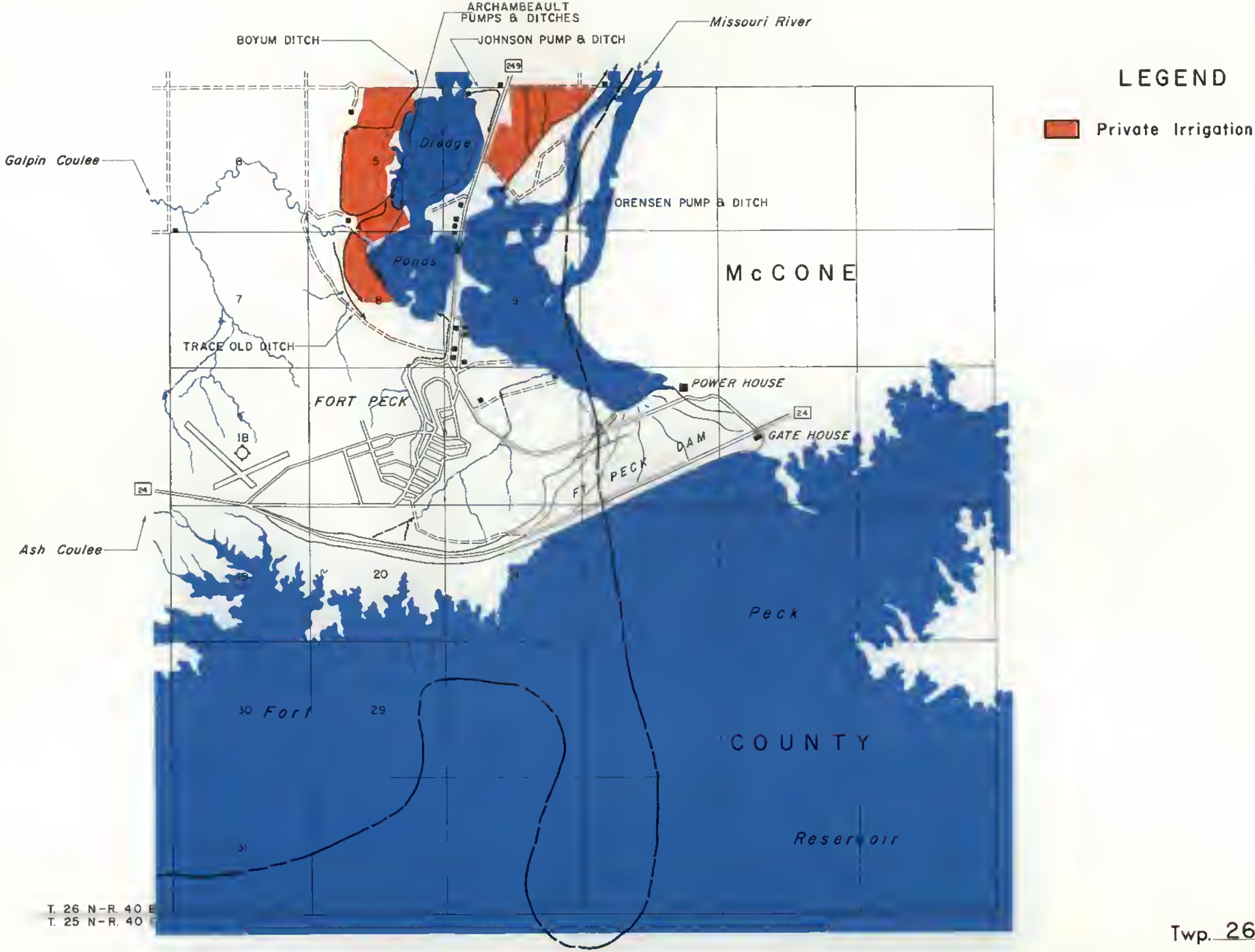
Twp. 26 North

Rge. 38 East



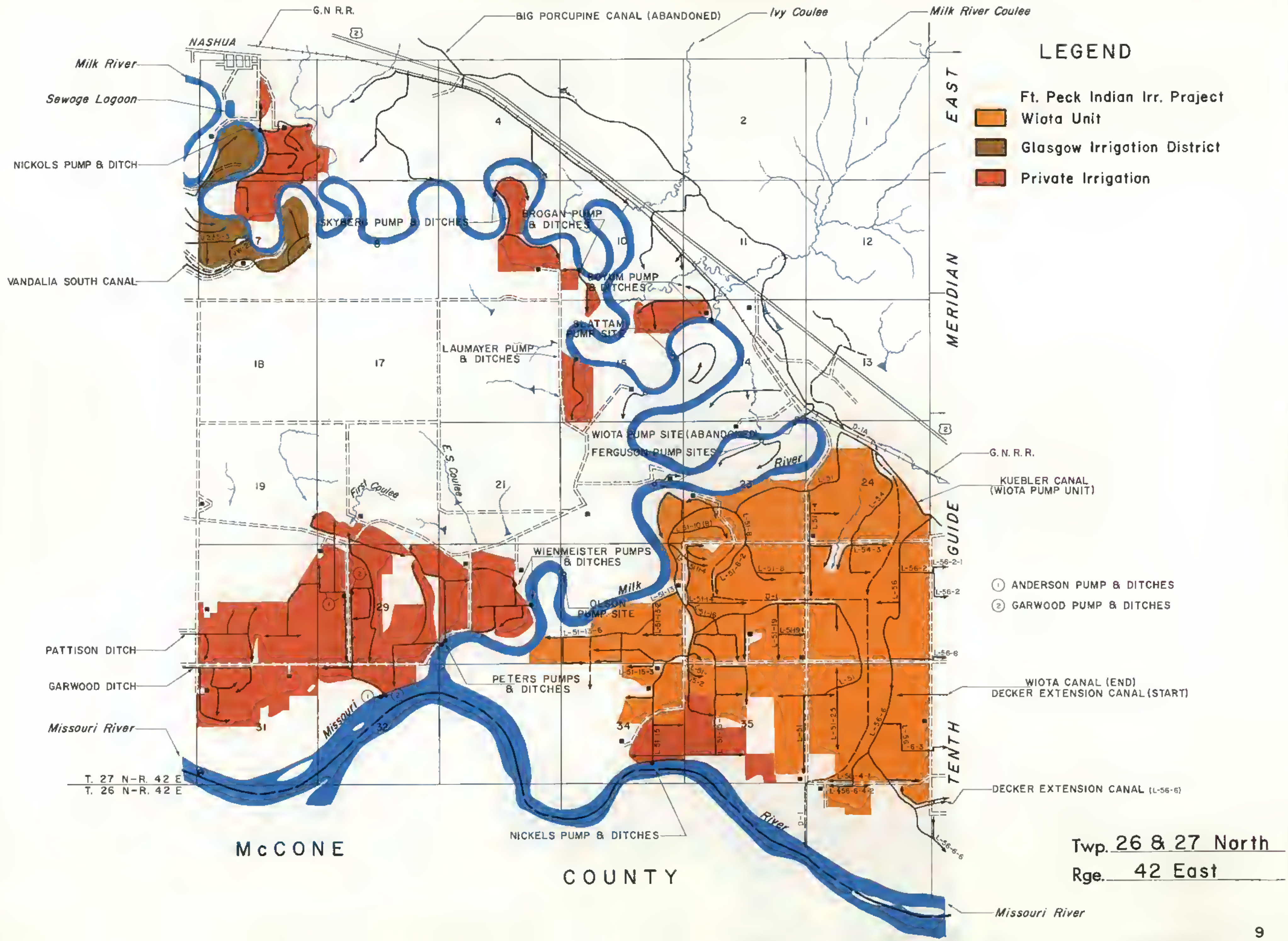
Twp. 26 North

Rge. 39 East

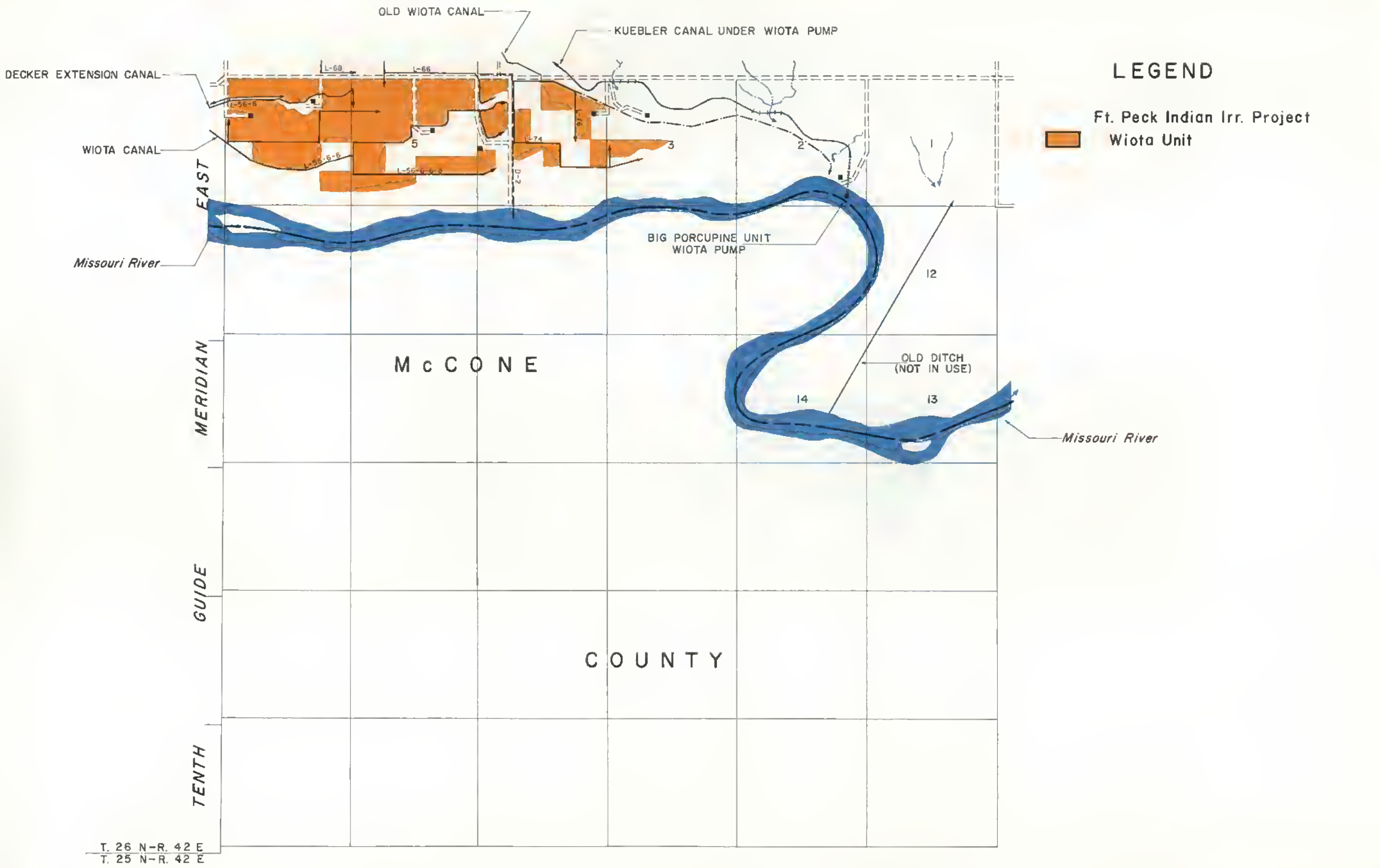


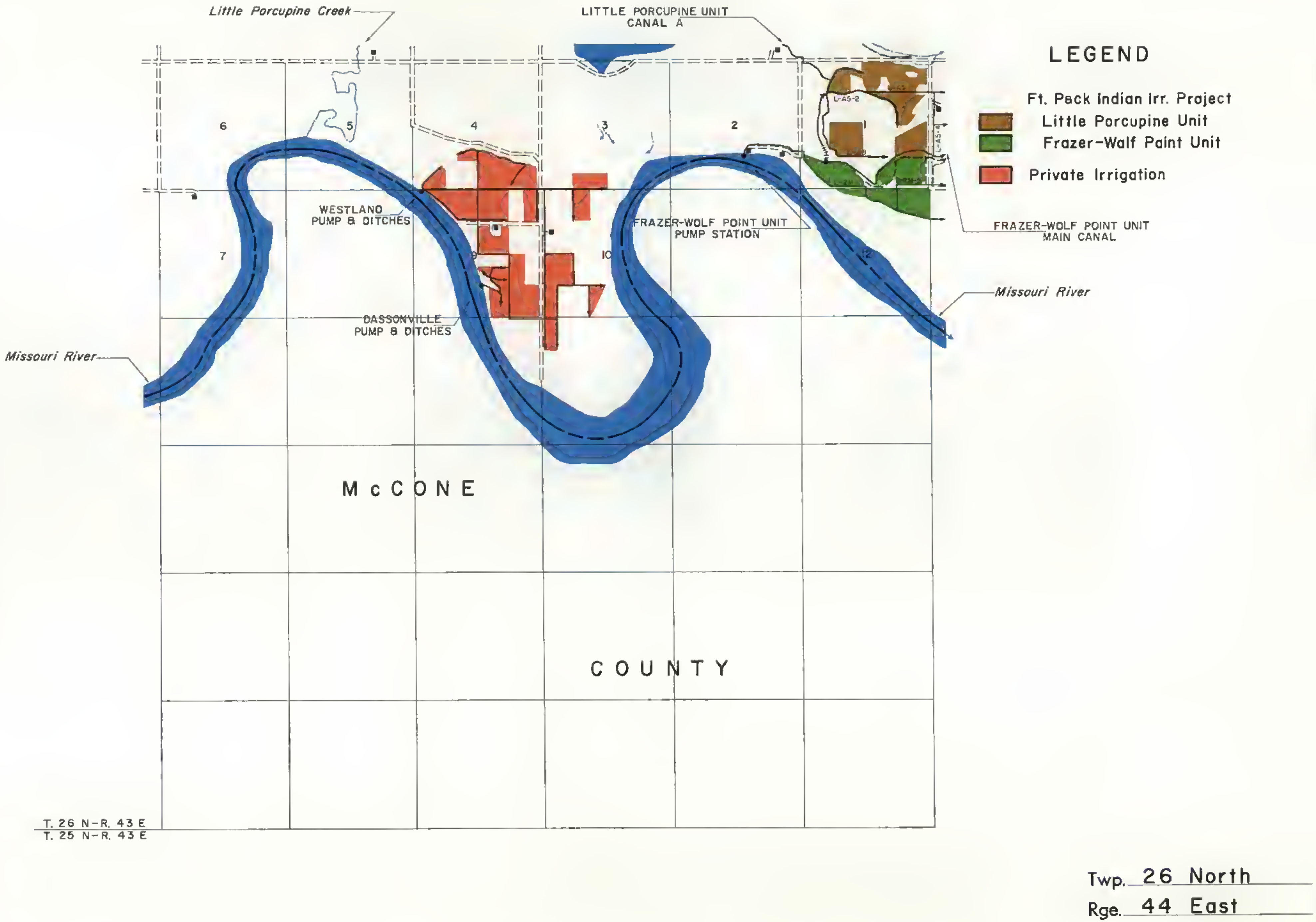
Twp. 26 North

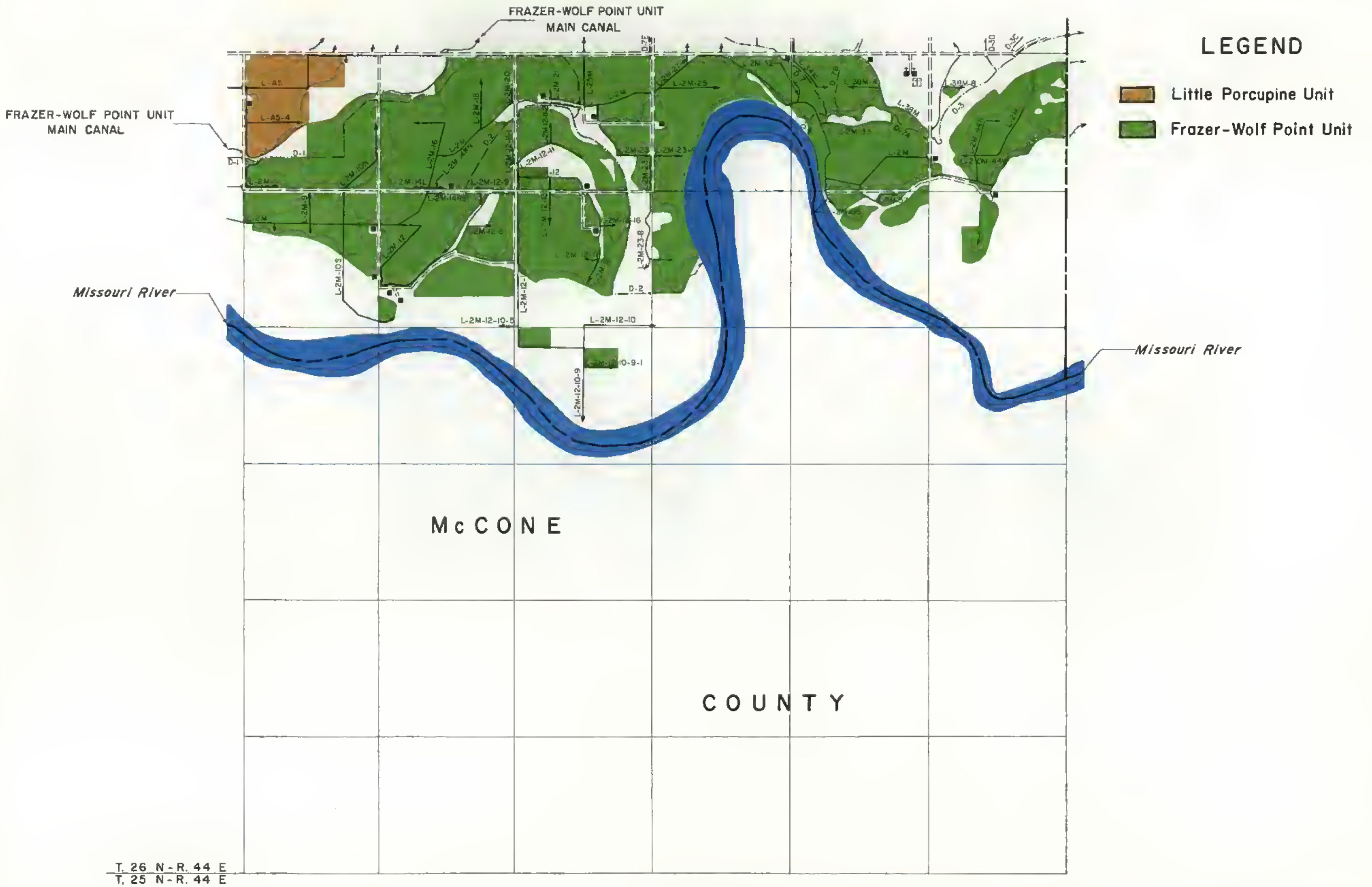
Rge. 41 East



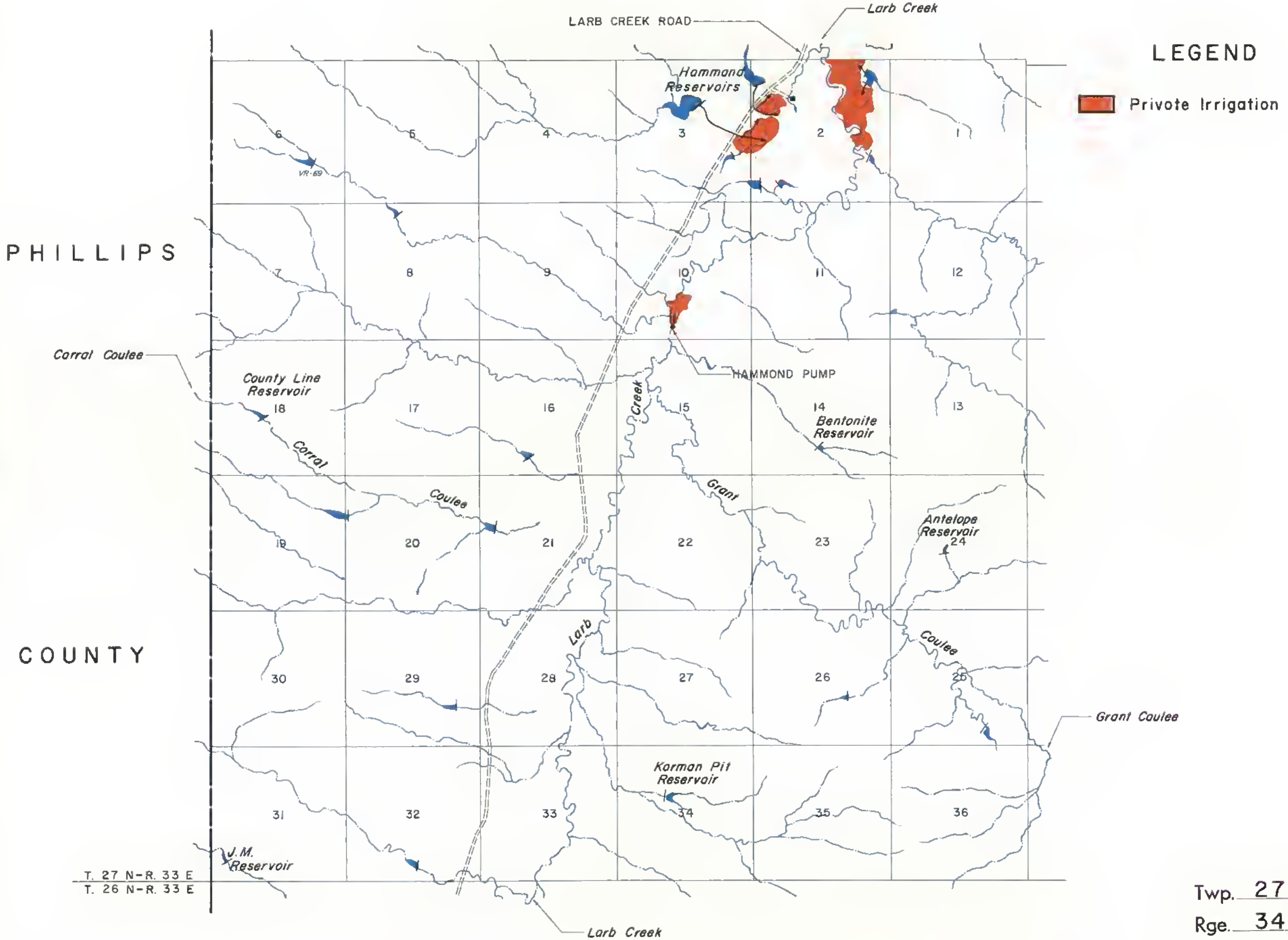
LEGEND
Ft. Peck Indian Irr. Project
Wiota Unit
Glasgow Irrigation District
Private Irrigation
G.N R.R.
NASHUA
Milk River
Sewage Lagoon
NICKOLS PUMP & DITCH
VANDALIA SOUTH CANAL
BIG PORCUPINE CANAL (ABANDONED)
Ivy Coulee
Milk River Coulee
SKYBERG PUMP & DITCHES
BROGAN PUMP & DITCHES
BOTTUM PUMP & DITCHES
SLATTAM PUMP SITE
LAUMAYER PUMP & DITCHES
WIOTA PUMP SITE (ABANDONED)
FERGUSON PUMP SITES
First Coulee
E.S. Coulee
WIENMEISTER PUMPS & DITCHES
OLSON PUMP SITE
PETERS PUMPS & DITCHES
NICKELS PUMP & DITCHES
PATTISON DITCH
GARWOOD DITCH
Missouri River
T. 27 N-R. 42 E
T. 26 N-R. 42 E
G. N. R. R.
KUEBLER CANAL (WIOTA PUMP UNIT)
1 ANDERSON PUMP & DITCHES
2 GARWOOD PUMP & DITCHES
WIOTA CANAL (END)
DECKER EXTENSION CANAL (START)
DECKER EXTENSION CANAL (L-56-6)
EAST MERIDIAN
TENTH GUIDE
McCONE COUNTY
Milk River
Missouri River
Twp. 26 & 27 North
Rge. 42 East


OLD WIOTA CANAL
KUEBLER CANAL UNDER WIOTA PUMP
DECKER EXTENSION CANAL
WIOTA CANAL
LEGEND
Ft. Peck Indian Irr. Project
Wiota Unit
Missouri River
BIG PORCUPINE UNIT
WIOTA PUMP
OLD DITCH
(NOT IN USE)
McCONE
COUNTY
EAST
MERIDIAN
GUIDE
TENTH
T. 26 N-R. 42 E
T. 25 N-R. 42 E
Twp. 26 North
Rge. 43 East


Little Porcupine Creek
LITTLE PORCUPINE UNIT CANAL A
LEGEND
Ft. Peck Indian Irr. Project
Little Porcupine Unit
Frazer-Wolf Point Unit
Private Irrigation
6
5
4
3
2
7
9
10
12
WESTLAND PUMP & DITCHES
FRAZER-WOLF POINT UNIT PUMP STATION
FRAZER-WOLF POINT UNIT MAIN CANAL
DASSONVILLE PUMP & DITCHES
Missouri River
Missouri River
McCONE
COUNTY
T. 26 N-R. 43 E
T. 25 N-R. 43 E
Twp. 26 North
Rge. 44 East

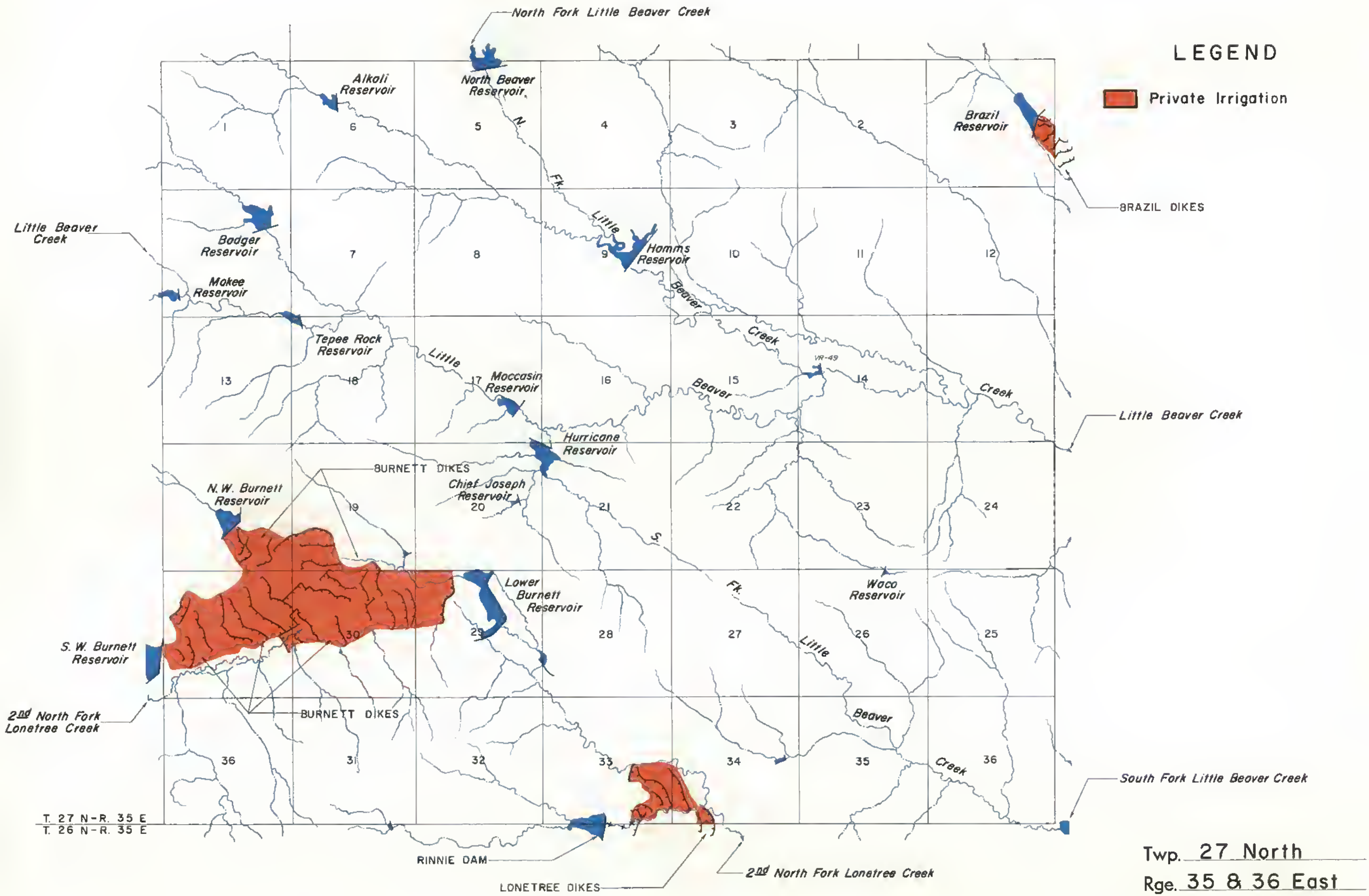


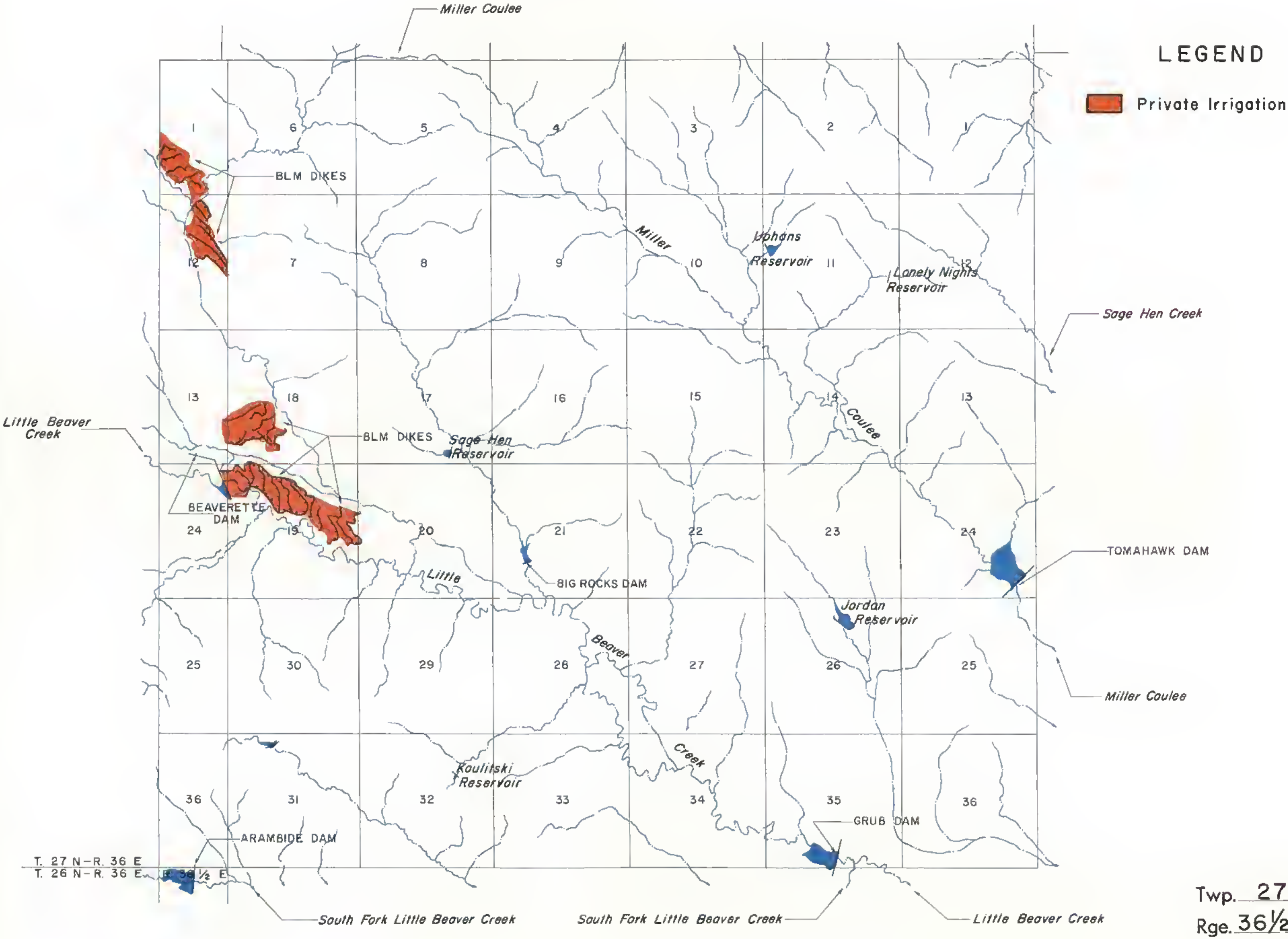
Twp. 26 North
Rge. 45 East

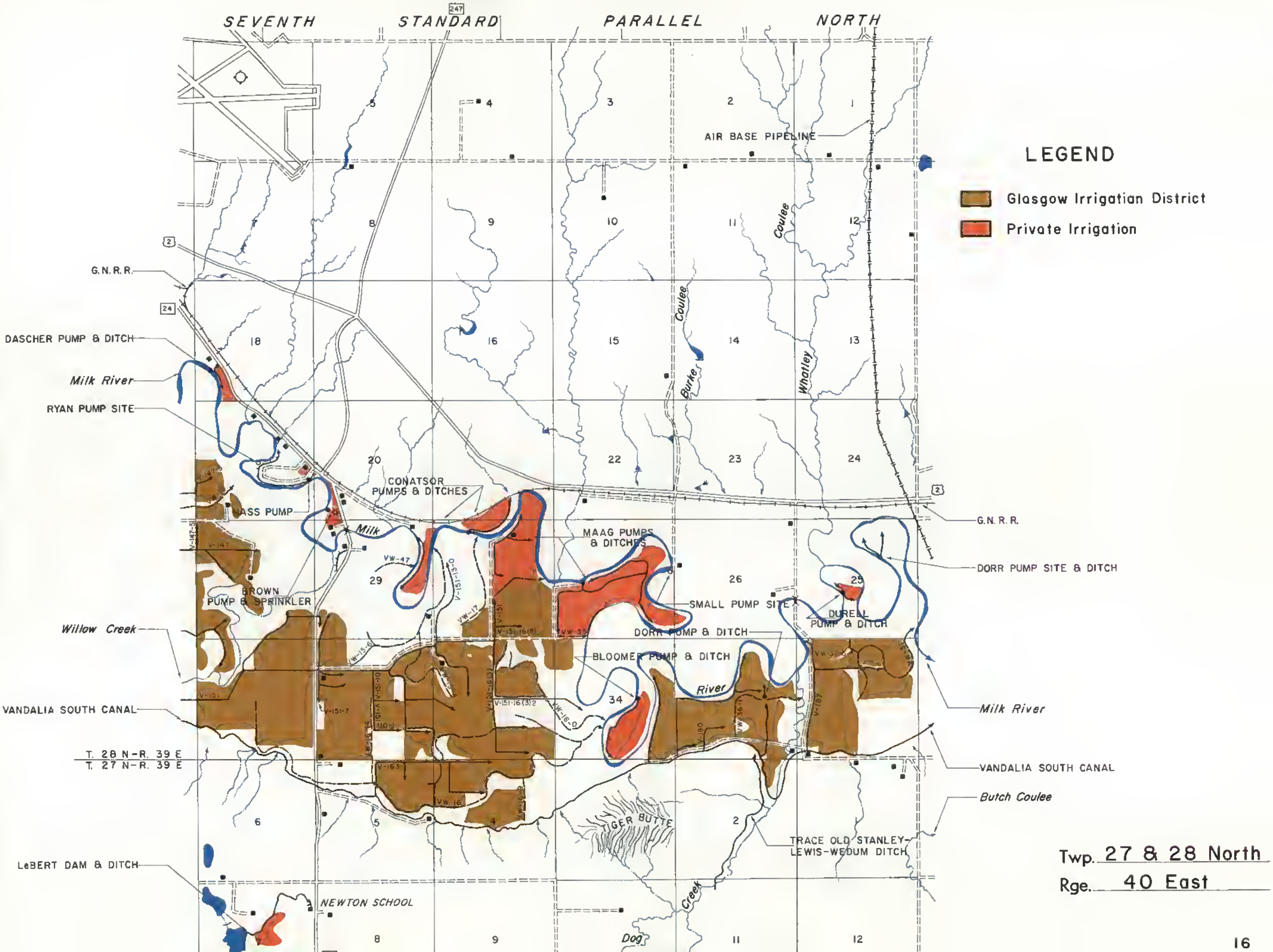


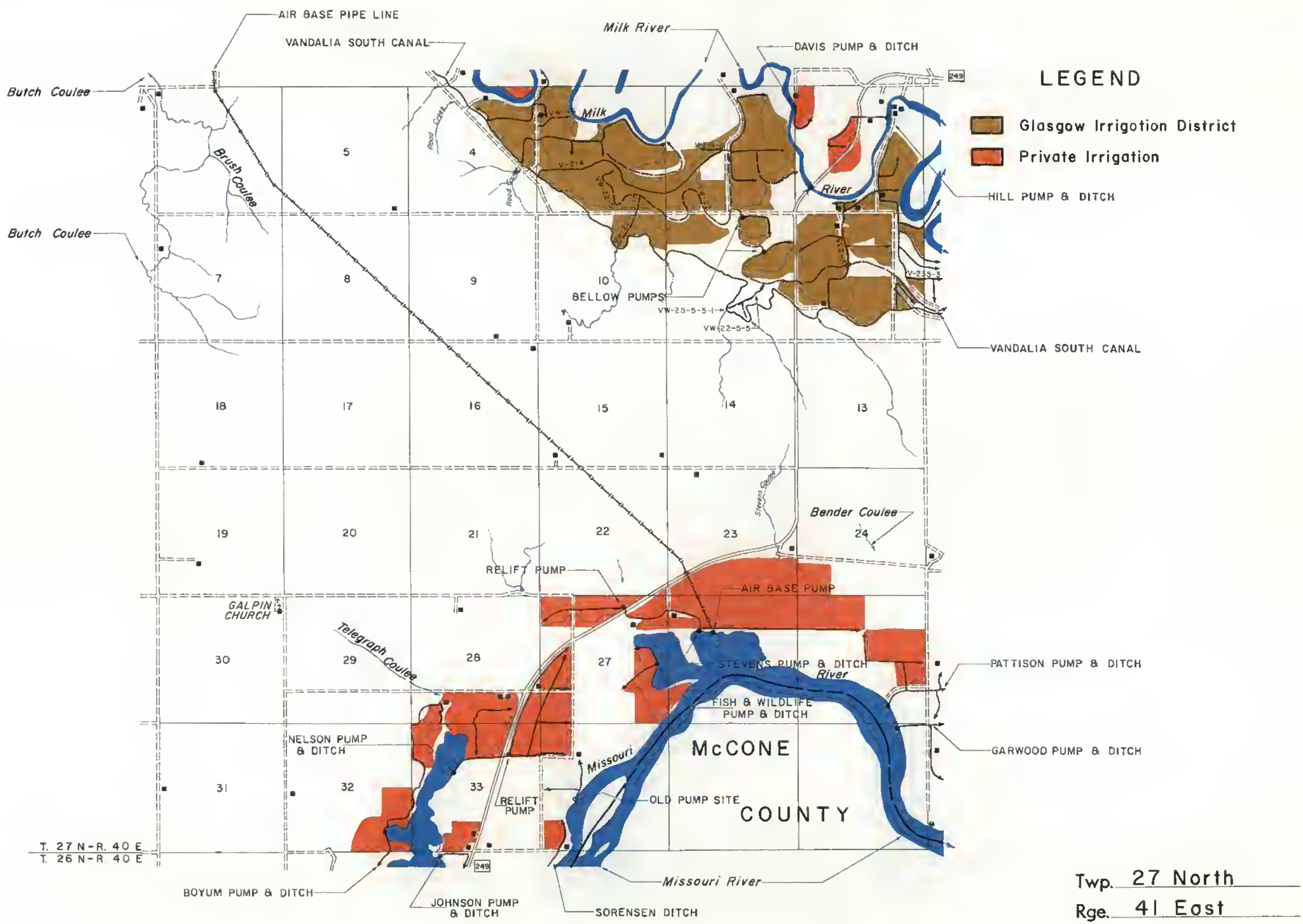
Twp. 27 North

Rge. 34 East


LEGEND
Private Irrigation
North Fork Little Beaver Creek
Alkali Reservoir
North Beaver Reservoir
Brazil Reservoir
BRAZIL DIKES
Little Beaver Creek
Badger Reservoir
Makee Reservoir
Hamms Reservoir
Tepee Rock Reservoir
Moccasin Reservoir
Hurricane Reservoir
VR-49
Little Beaver Creek
BURNETT DIKES
N.W. Burnett Reservoir
Chief Joseph Reservoir
Lower Burnett Reservoir
Waco Reservoir
S.W. Burnett Reservoir
2nd North Fork Lonetree Creek
BURNETT DIKES
South Fork Little Beaver Creek
T. 27 N-R. 35 E
T. 26 N-R. 35 E
RINNIE DAM
LONETREE DIKES
2nd North Fork Lonetree Creek
N. Fk. Little Beaver Creek
Little Beaver Creek
S. Fk. Little Beaver Creek
Twp. 27 North
Rge. 35 & 36 East

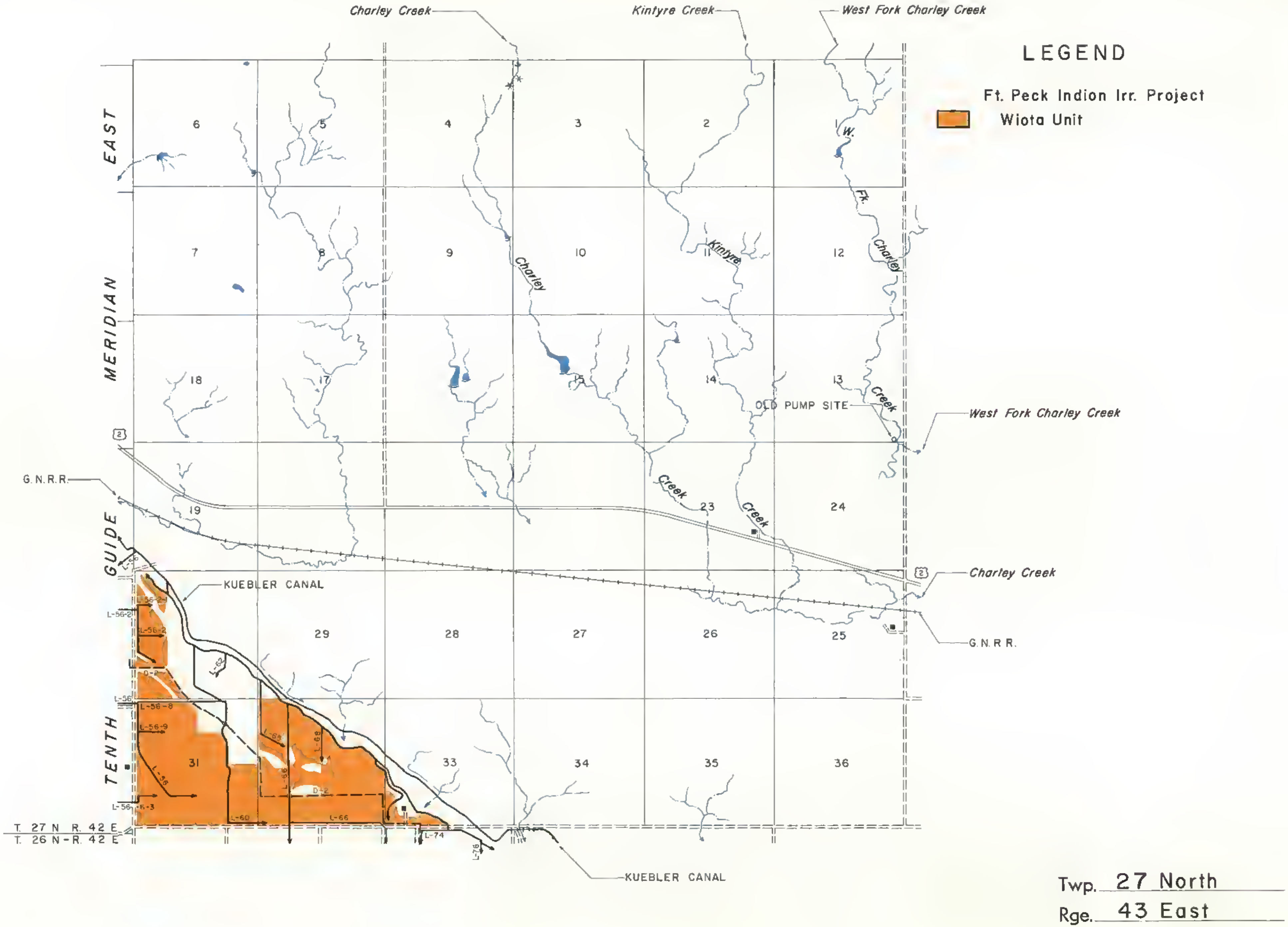

LEGEND
Private Irrigation
Miller Coulee
BLM DIKES
Miller
Johans Reservoir
Lonely Nights Reservoir
Sage Hen Creek
Coulee
Little Beaver Creek
BLM DIKES
Sage Hen Reservoir
BEAVERETTE DAM
TOMAHAWK DAM
Little
BIG ROCKS DAM
Jordan Reservoir
Beaver
Miller Coulee
Creek
Koulitski Reservoir
GRUB DAM
ARAMBIDE DAM
T. 27 N-R. 36 E
T. 26 N-R. 36 E
R. 36 ½ E
South Fork Little Beaver Creek
South Fork Little Beaver Creek
Little Beaver Creek
Twp. 27 North
Rge. 36½ & 37 East

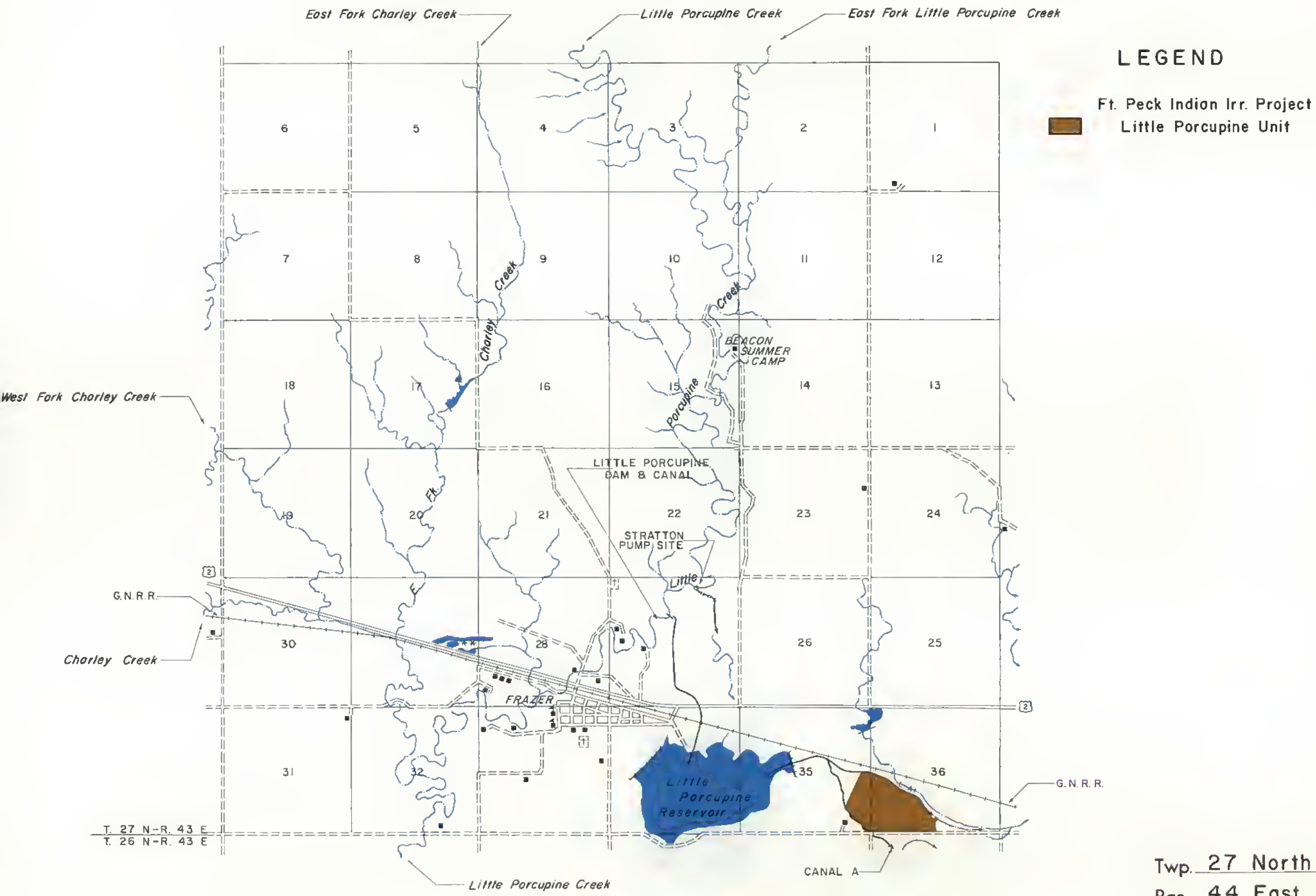

SEVENTH STANDARD PARALLEL NORTH
LEGEND
Glasgow Irrigation District
Private Irrigation
AIR BASE PIPELINE
G.N.R.R.
DASCHER PUMP & DITCH
Milk River
RYAN PUMP SITE
CONATSOR PUMPS & DITCHES
MASS PUMP
Milk
MAAG PUMPS & DITCHES
BROWN PUMP & SPRINKLER
SMALL PUMP SITE
DURELL PUMP & DITCH
DORR PUMP SITE & DITCH
DORR PUMP & DITCH
BLOOMER PUMP & DITCH
River
Willow Creek
VANDALIA SOUTH CANAL
T. 28 N - R. 39 E
T. 27 N - R. 39 E
Coulee
Burke
Whatley
TIGER BUTTE
TRACE OLD STANLEY-LEWIS-WEDUM DITCH
Butch Coulee
LeBERT DAM & DITCH
NEWTON SCHOOL
Dog
Creek
Twp. 27 & 28 North
Rge. 40 East



Twp. 27 North

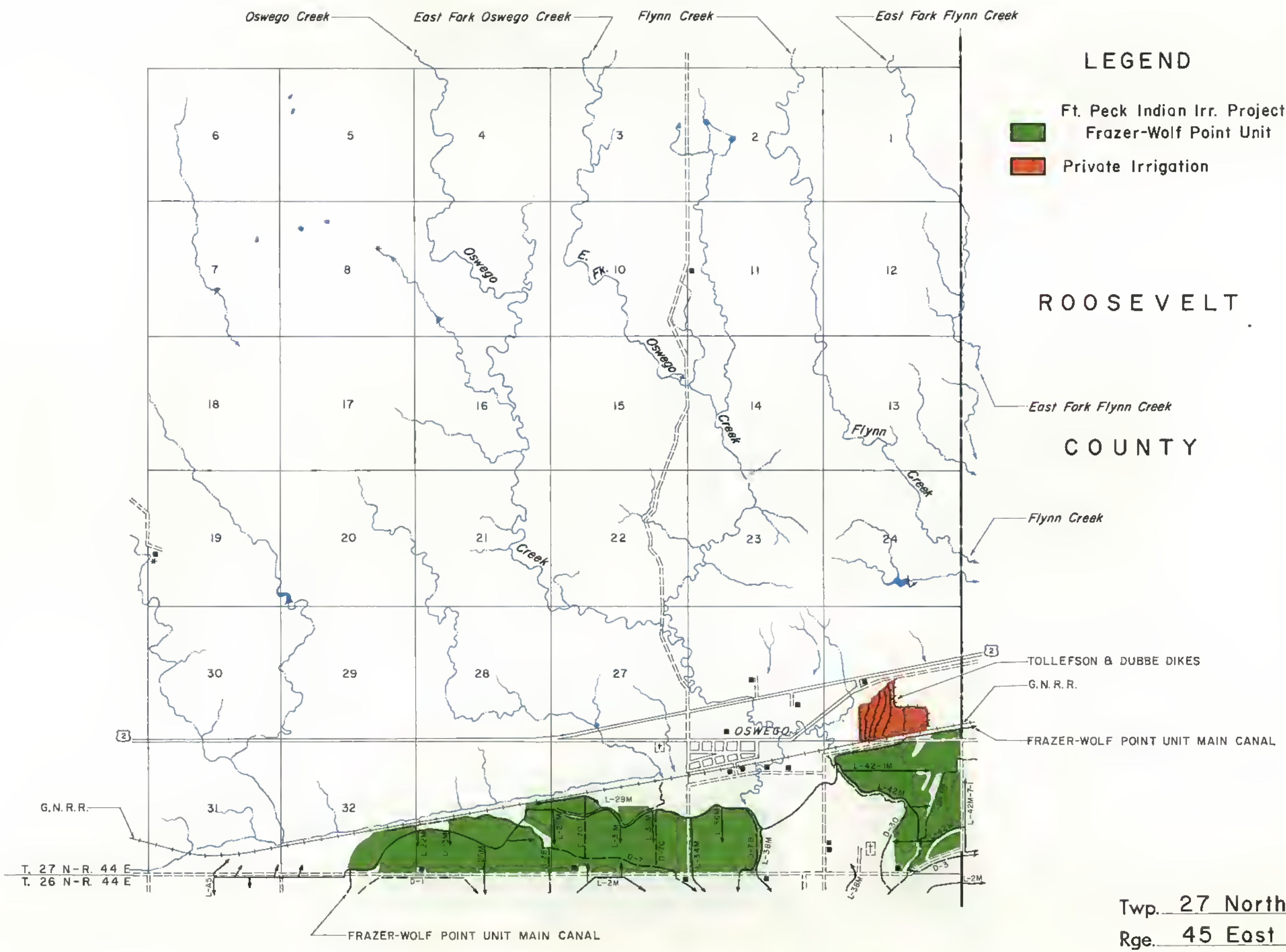
Rge. 41 East


LEGEND
Ft. Peck Indion Irr. Project
Wiota Unit
Charley Creek
Kintyre Creek
West Fork Charley Creek
EAST
MERIDIAN
GUIDE
TENTH
G. N. R. R.
KUEBLER CANAL
OLD PUMP SITE
T. 27 N. R. 42 E.
T. 26 N - R. 42 E.
Twp. 27 North
Rge. 43 East



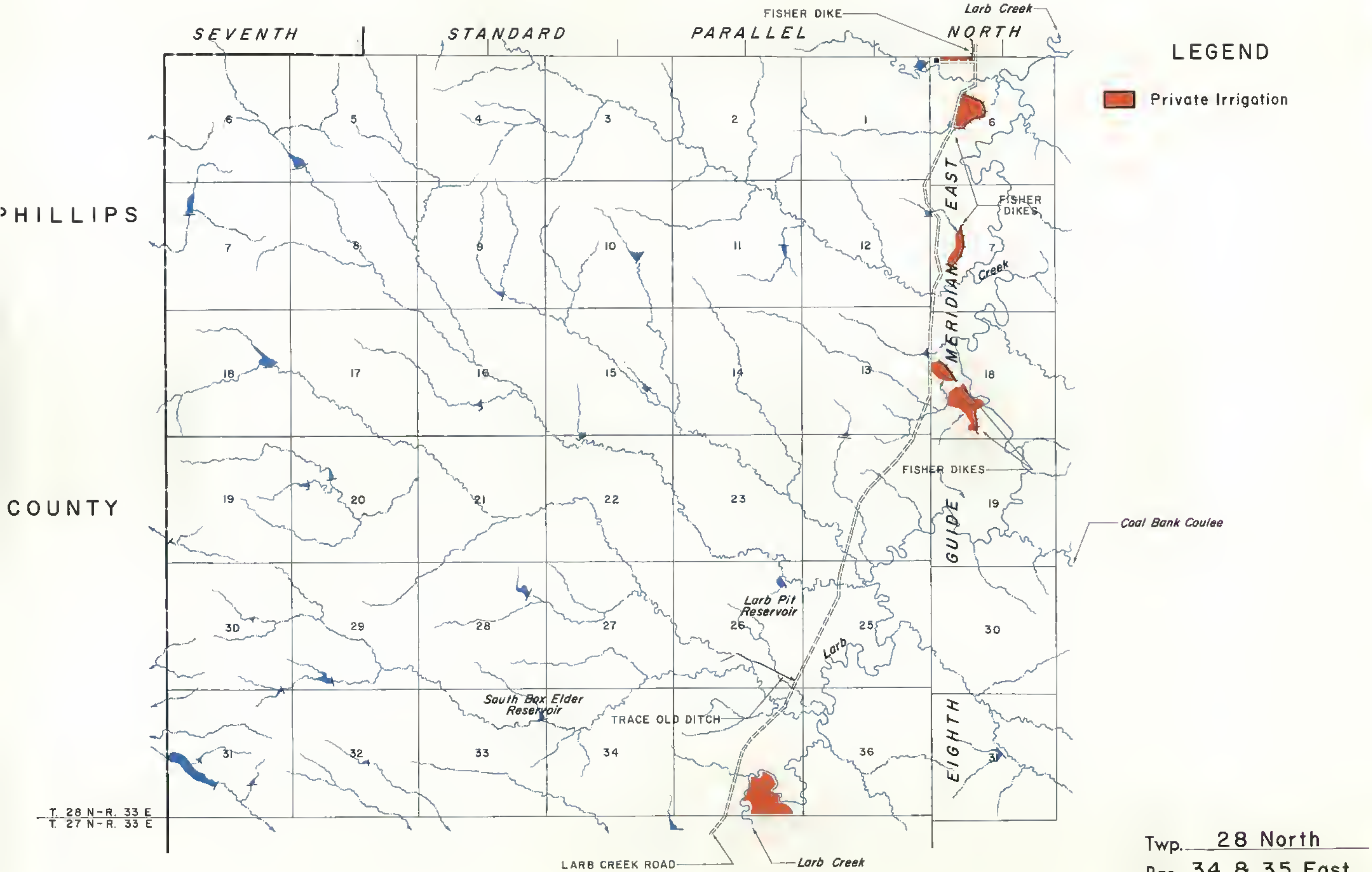
Twp. 27 North

Rge. 44 East



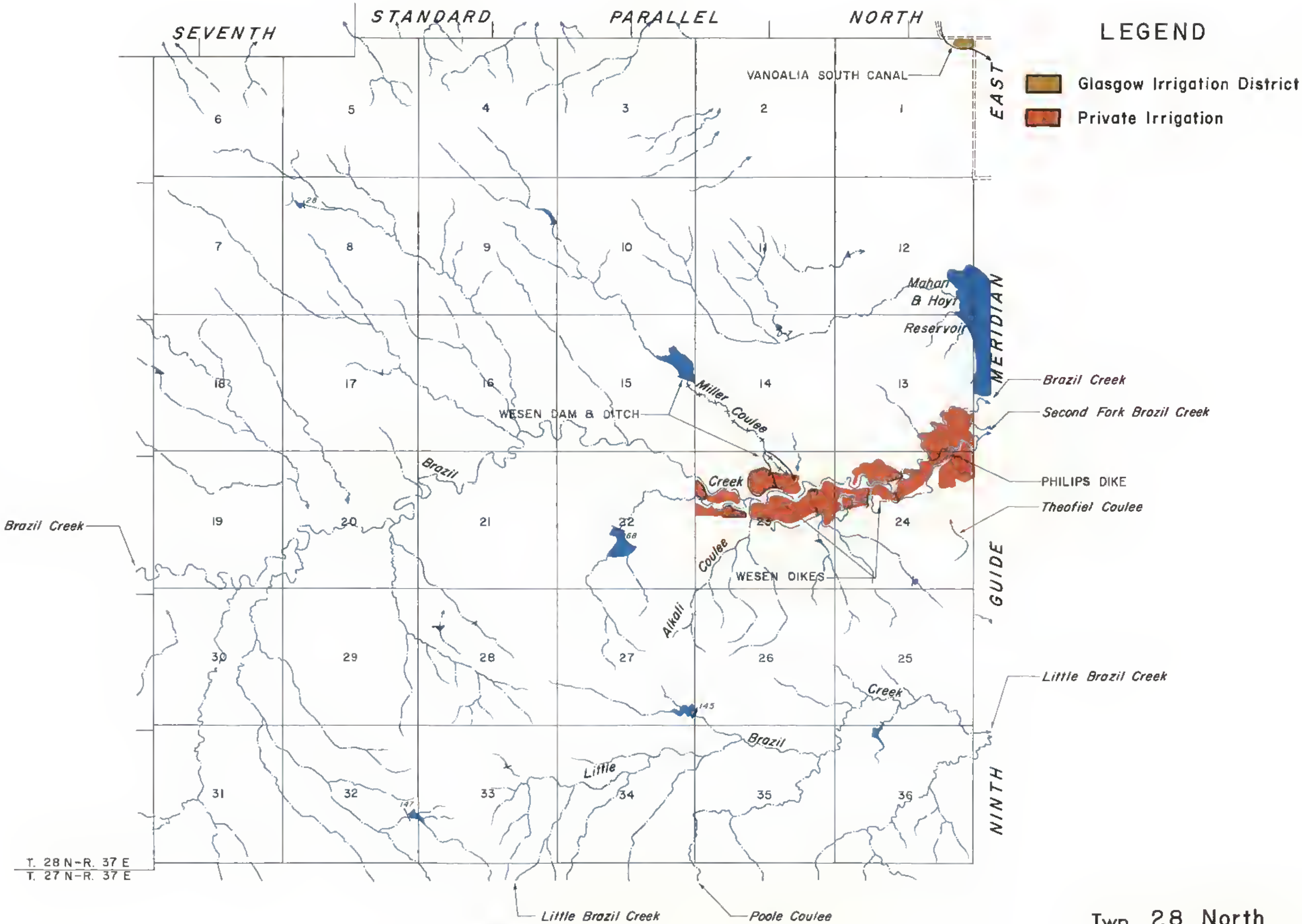
Twp. 27 North

Rge. 45 East



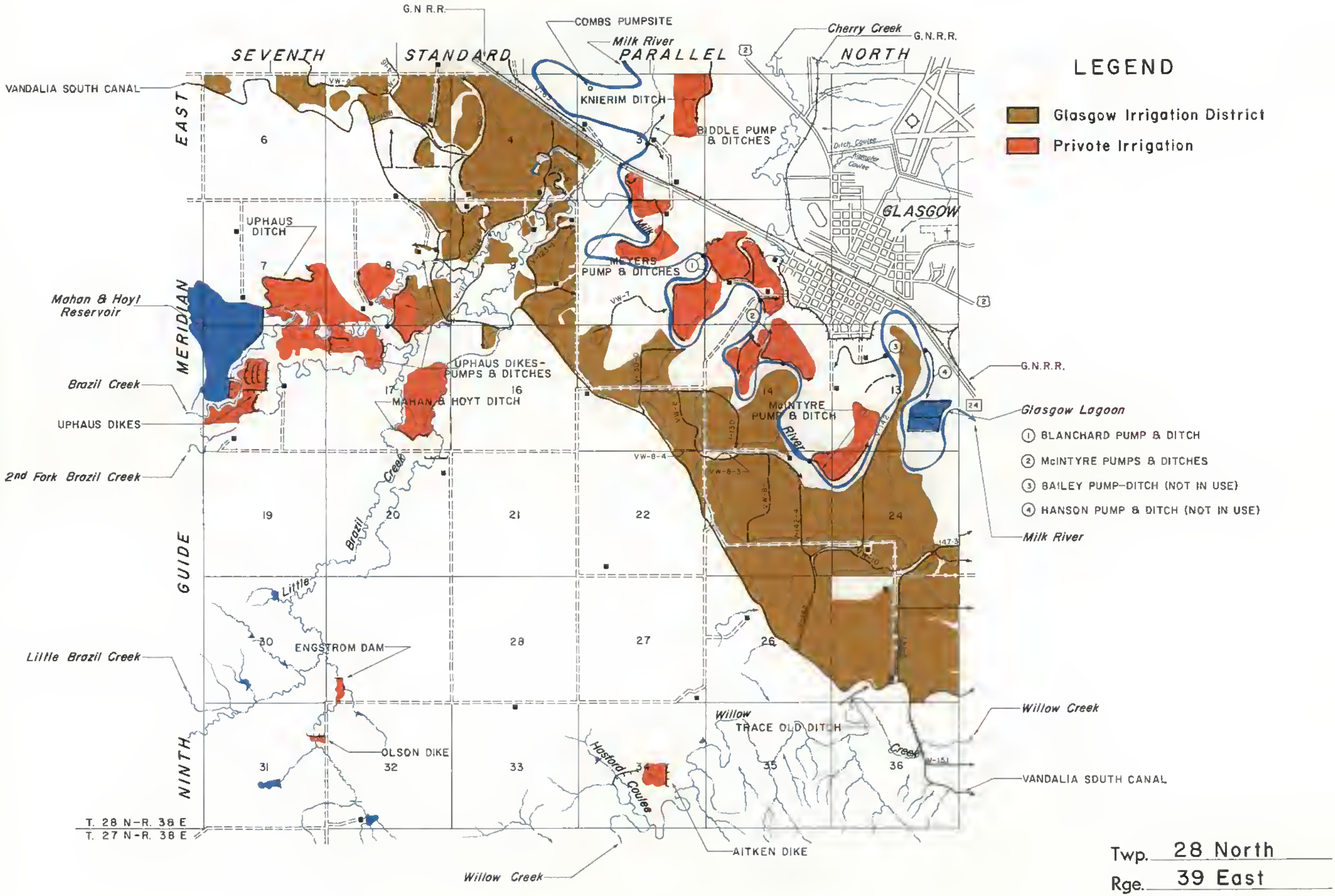
Twp. 28 North

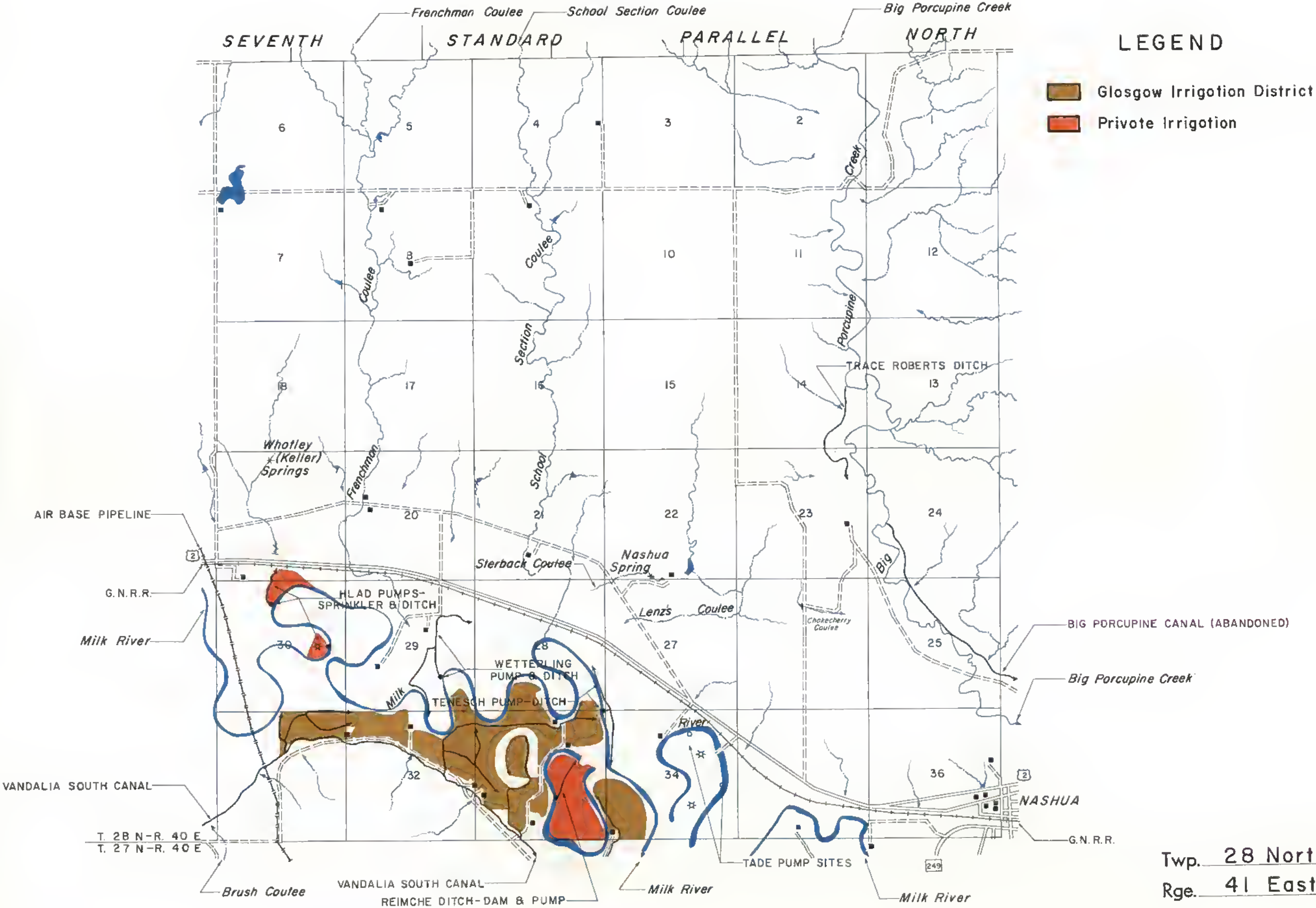
Rge. 34 & 35 East



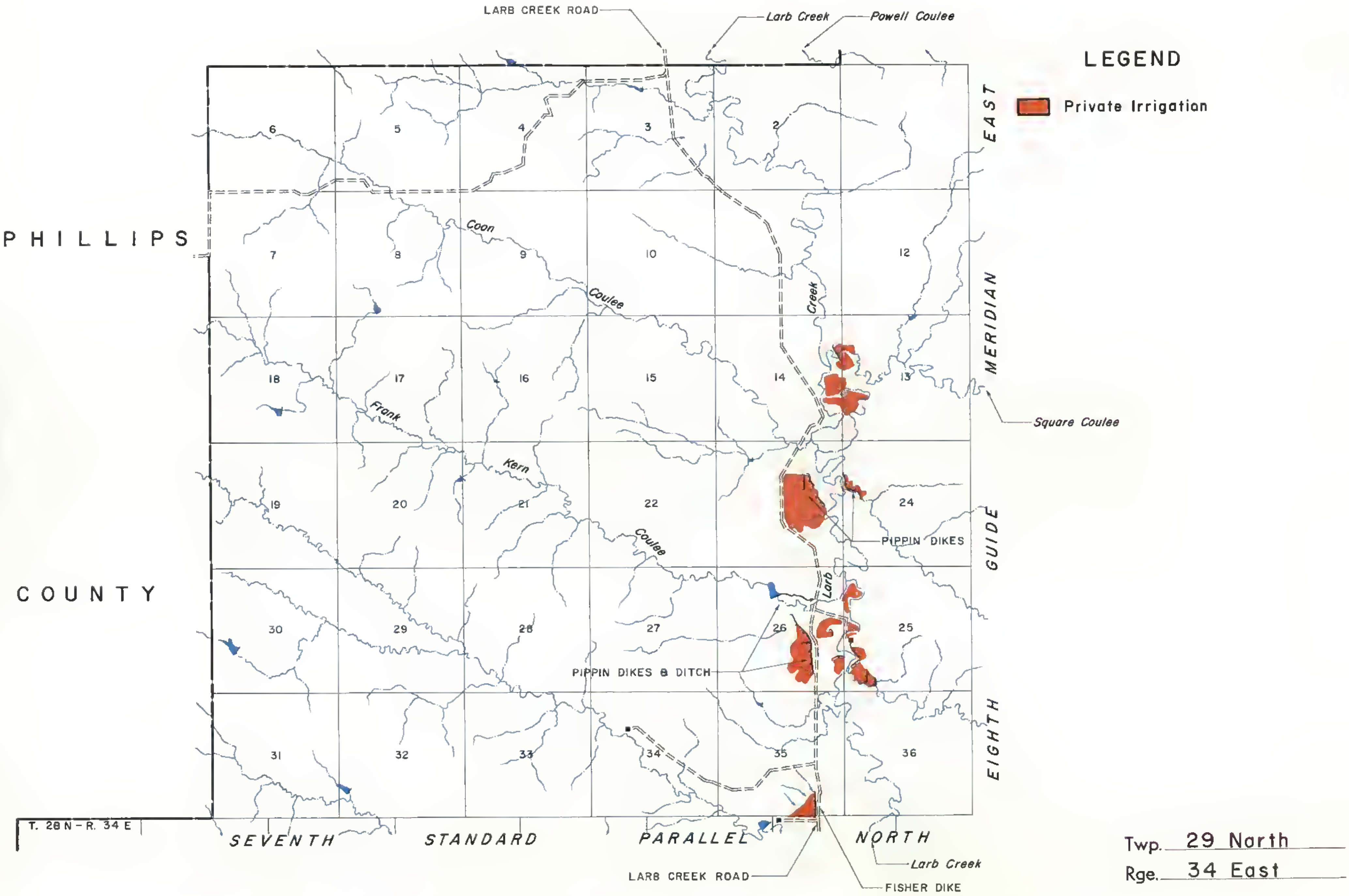
Twp. 28 North

Rge. 38 East


LEGEND
Glasgow Irrigation District
Private Irrigation
SEVENTH STANDARD PARALLEL NORTH
EAST MERIDIAN GUIDE NINTH
G.N.R.R.
COMBS PUMPSITE
Milk River
Cherry Creek
VANDALIA SOUTH CANAL
KNIERIM DITCH
BIDDLE PUMP & DITCHES
GLASGOW
UPHAUS DITCH
MEYERS PUMP & DITCHES
Mahan & Hoyt Reservoir
UPHAUS DIKES-PUMPS & DITCHES
MAHAN & HOYT DITCH
Brazil Creek
UPHAUS DIKES
McINTYRE PUMP & DITCH
Glasgow Lagoon
① BLANCHARD PUMP & DITCH
② McINTYRE PUMPS & DITCHES
③ BAILEY PUMP-DITCH (NOT IN USE)
④ HANSON PUMP & DITCH (NOT IN USE)
2nd Fork Brazil Creek
Little Brazil Creek
ENGSTROM DAM
OLSON DIKE
Willow Creek
TRACE OLD DITCH
Hosford Coulee
AITKEN DIKE
T. 28 N-R. 38 E
T. 27 N-R. 38 E
Twp. 28 North
Rge. 39 East

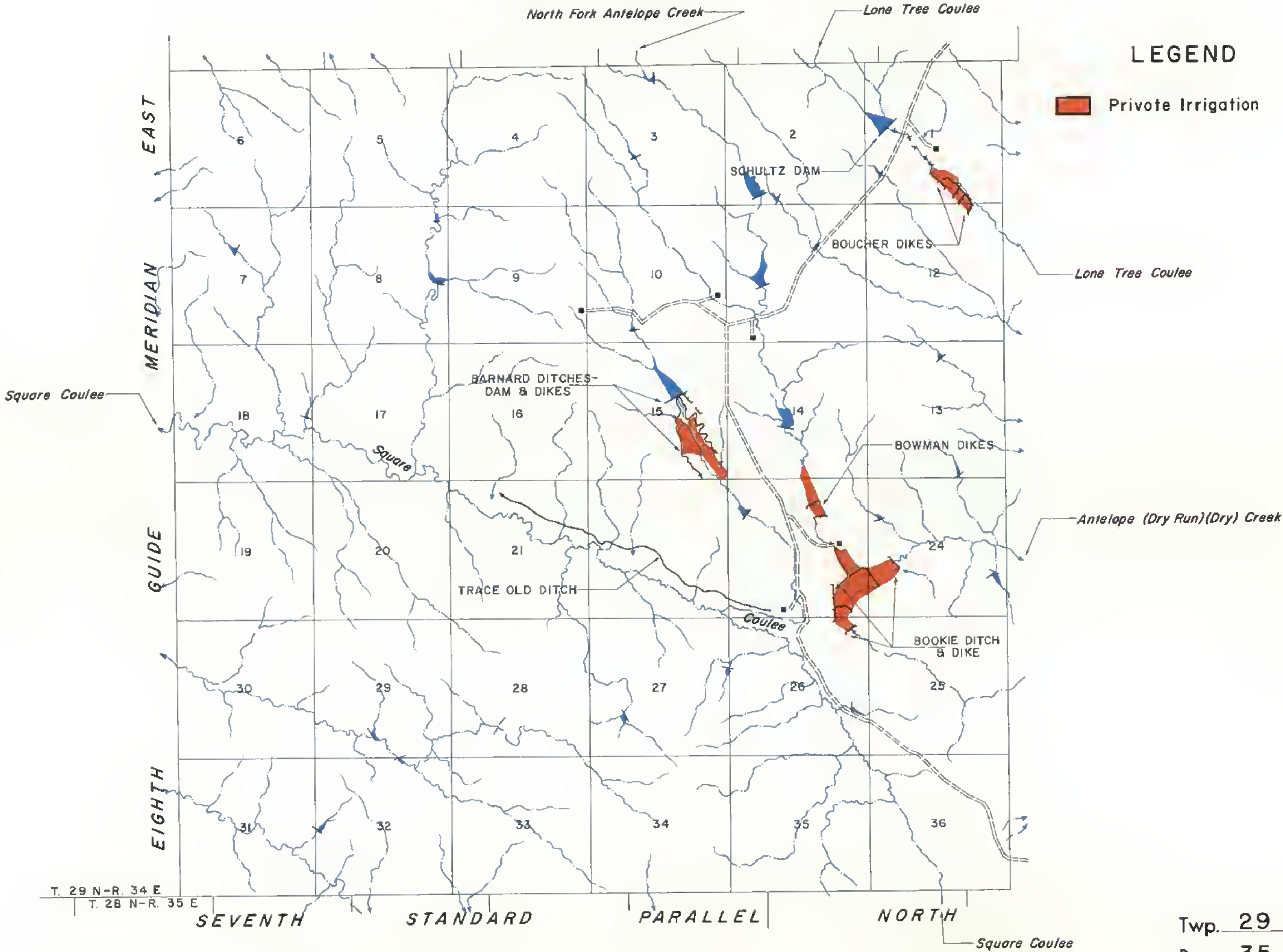


Twp. 28 North
Rge. 41 East



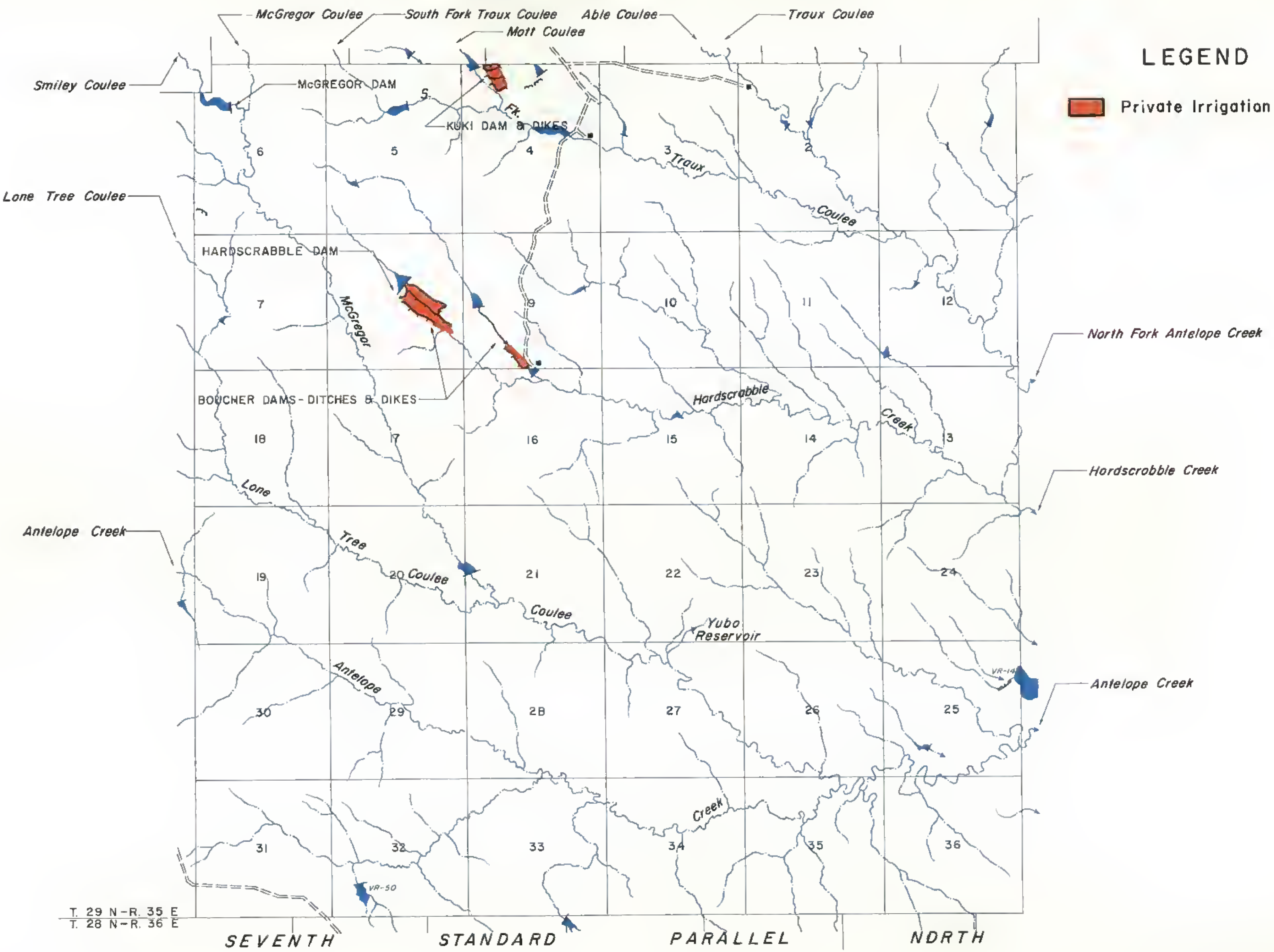
Twp. 29 North

Rge. 34 East



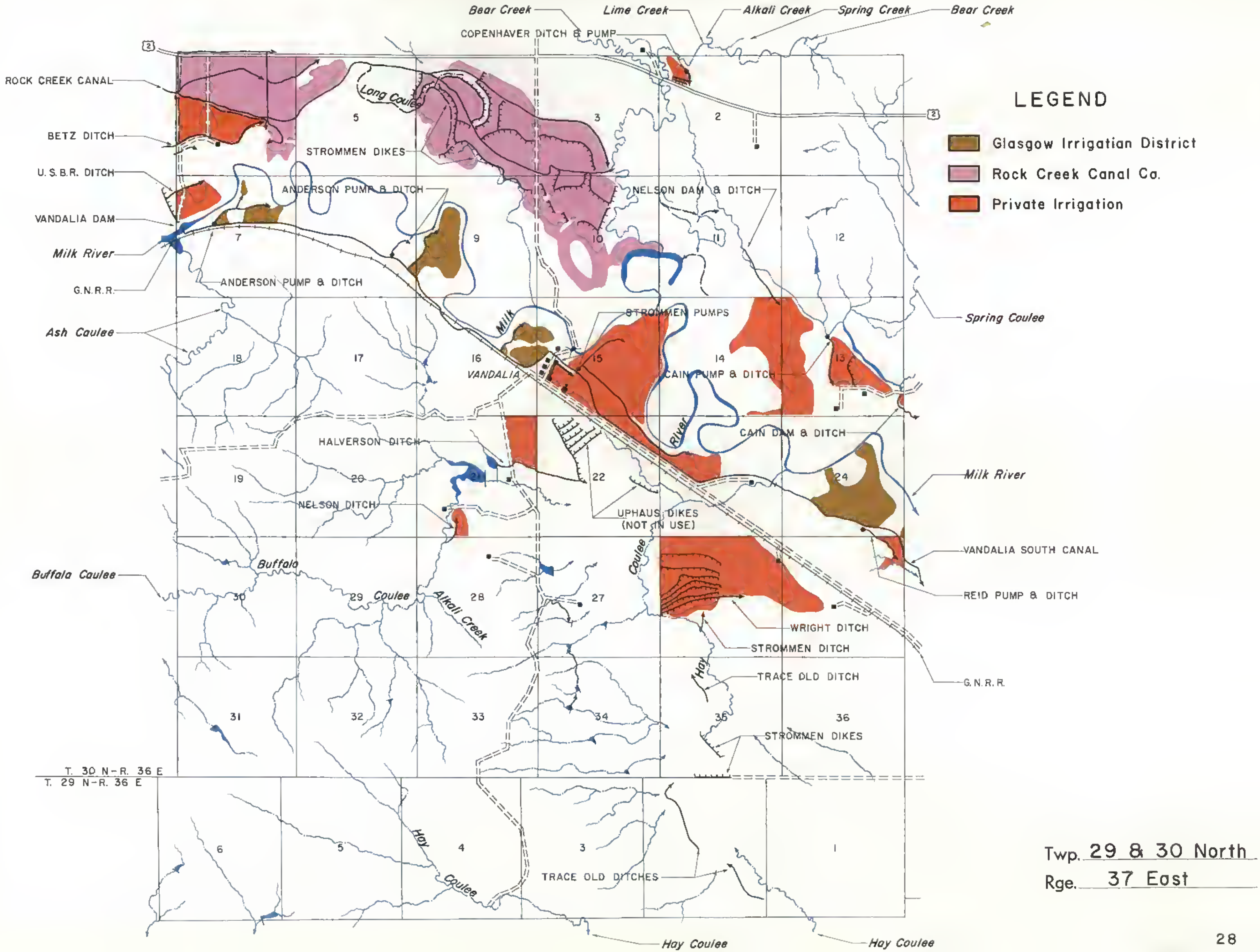
Twp. 29 North

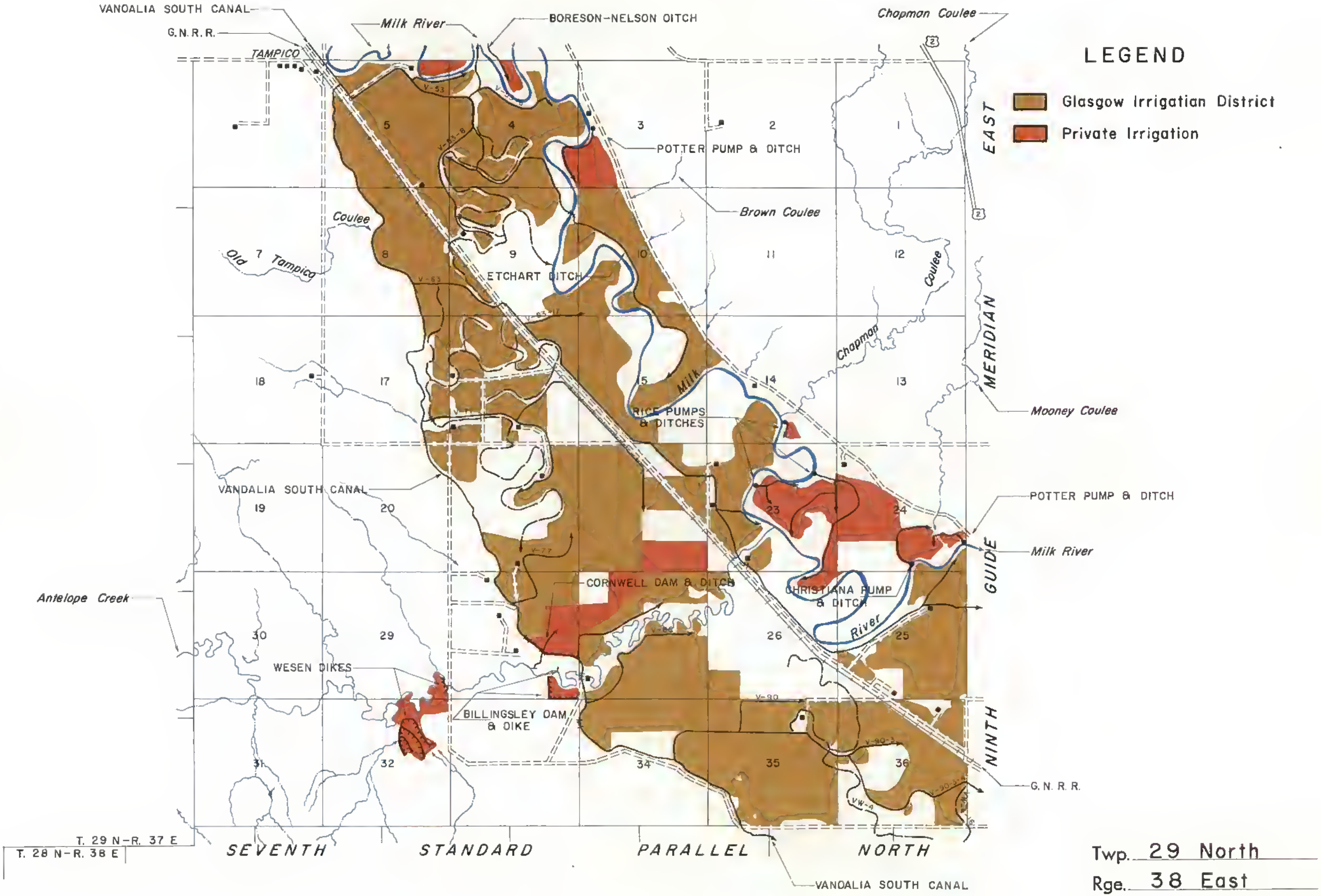
Rge. 35 East



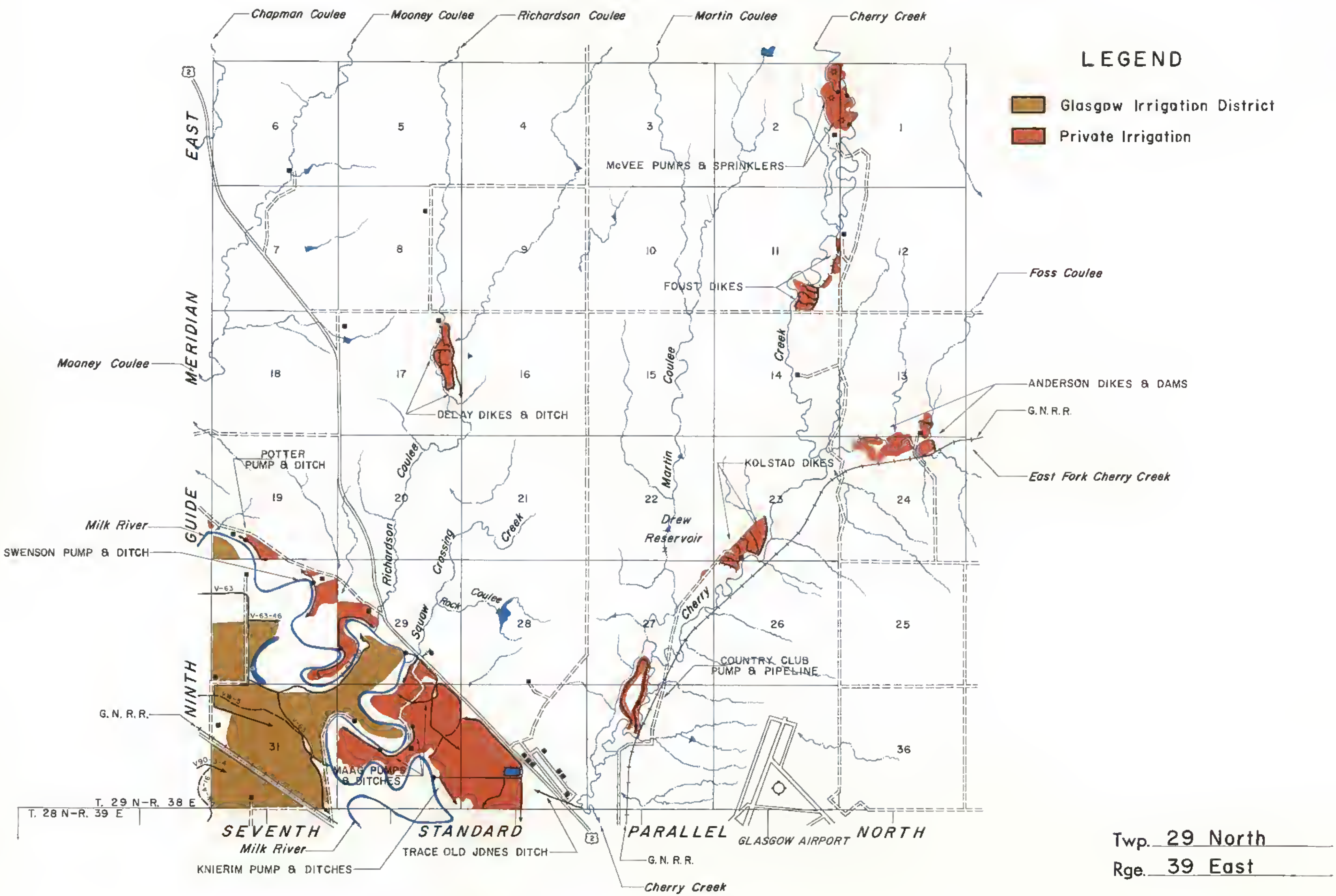
Twp. 29 North

Rge. 36 East

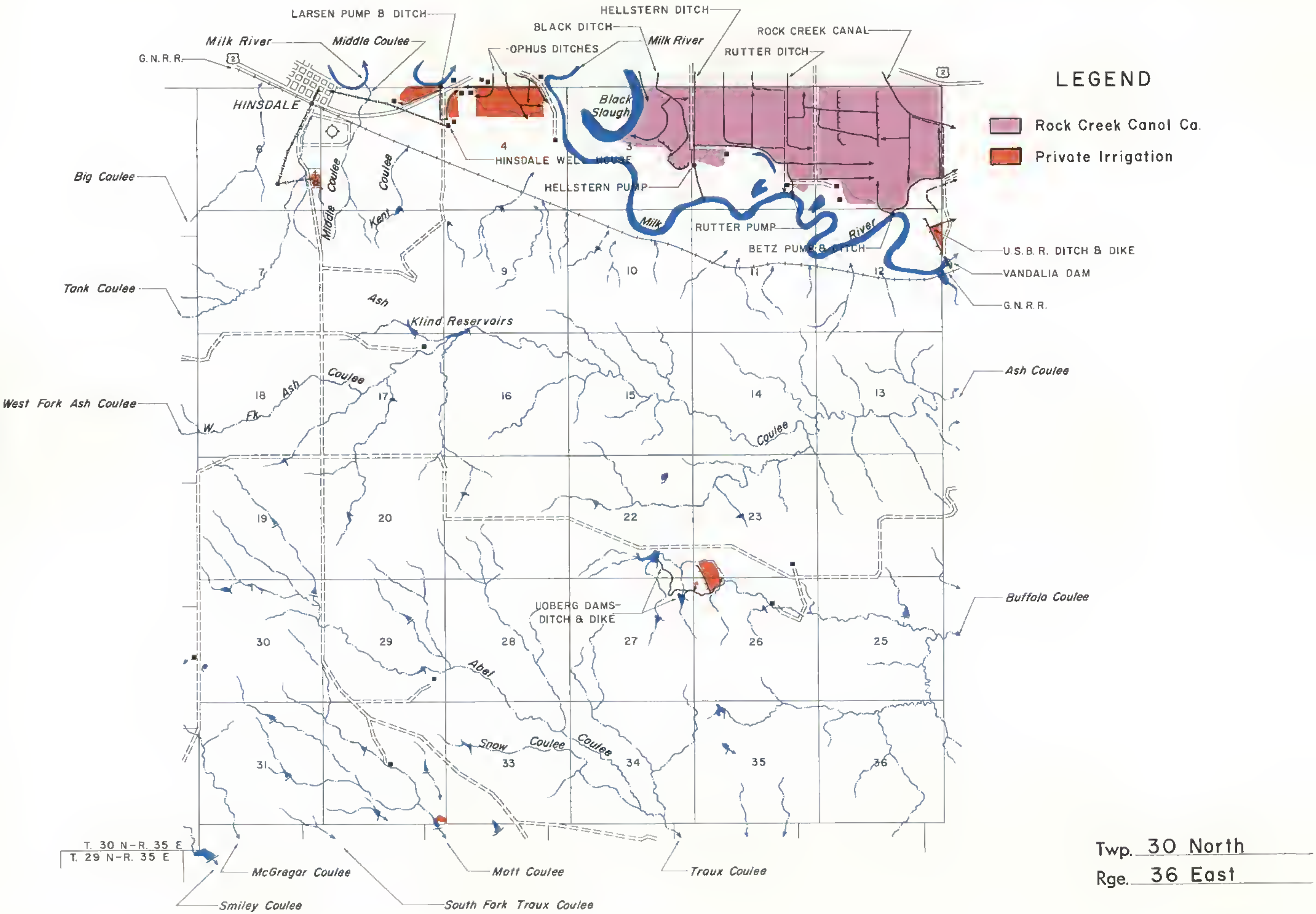

Bear Creek
Lime Creek
Alkali Creek
Spring Creek
Bear Creek
COPENHAVER DITCH & PUMP
ROCK CREEK CANAL
BETZ DITCH
U. S. B. R. DITCH
VANDALIA DAM
Milk River
G. N. R. R.
Ash Coulee
Buffalo Coulee
Long Coulee
STROMMEN DIKES
ANDERSON PUMP & DITCH
NELSON DAM & DITCH
STROMMEN PUMPS
CAIN PUMP & DITCH
CAIN DAM & DITCH
VANDALIA
Milk River
HALVERSON DITCH
NELSON DITCH
UPHAUS DIKES
(NOT IN USE)
Buffalo
Coulee
Alkali Creek
Coulee
WRIGHT DITCH
STROMMEN DITCH
TRACE OLD DITCH
STROMMEN DIKES
Hay
Hay Coulee
TRACE OLD DITCHES
Hay Coulee
Hay Coulee
Spring Coulee
Milk River
VANDALIA SOUTH CANAL
REID PUMP & DITCH
G. N. R. R.
T. 30 N - R. 36 E
T. 29 N - R. 36 E
LEGEND
Glasgow Irrigation District
Rock Creek Canal Co.
Private Irrigation
Twp. 29 & 30 North
Rge. 37 East



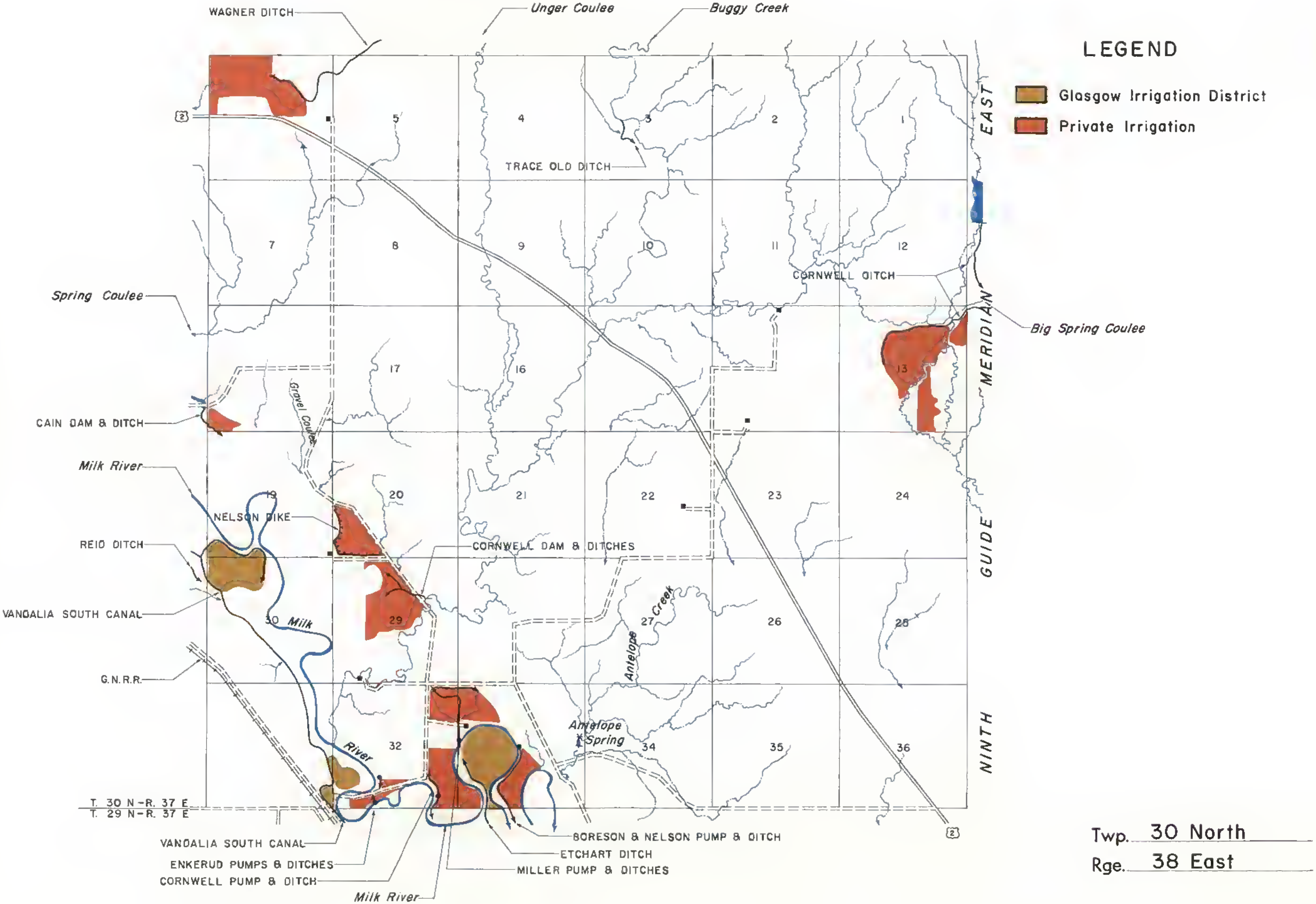
VANOALIA SOUTH CANAL
G. N. R. R.
TAMPICO
Milk River
BORESON-NELSON OITCH
Chopmon Coulee
LEGEND
Glasgow Irrigation District
Private Irrigation
POTTER PUMP & DITCH
Brown Coulee
Coulee
Old Tampico
ETCHART DITCH
Coulee
Chapman
Milk
RICE PUMPS & DITCHES
Mooney Coulee
VANDALIA SOUTH CANAL
POTTER PUMP & DITCH
Milk River
CORNWELL DAM & DITCH
CHRISTIANA PUMP & DITCH
River
Antelope Creek
WESEN DIKES
BILLINGSLEY DAM & DIKE
G. N. R. R.
EAST MERIDIAN
NINTH GUIDE
T. 29 N-R. 37 E
T. 28 N-R. 38 E
SEVENTH STANDARD PARALLEL NORTH
VANOALIA SOUTH CANAL
Twp. 29 North
Rge. 38 East

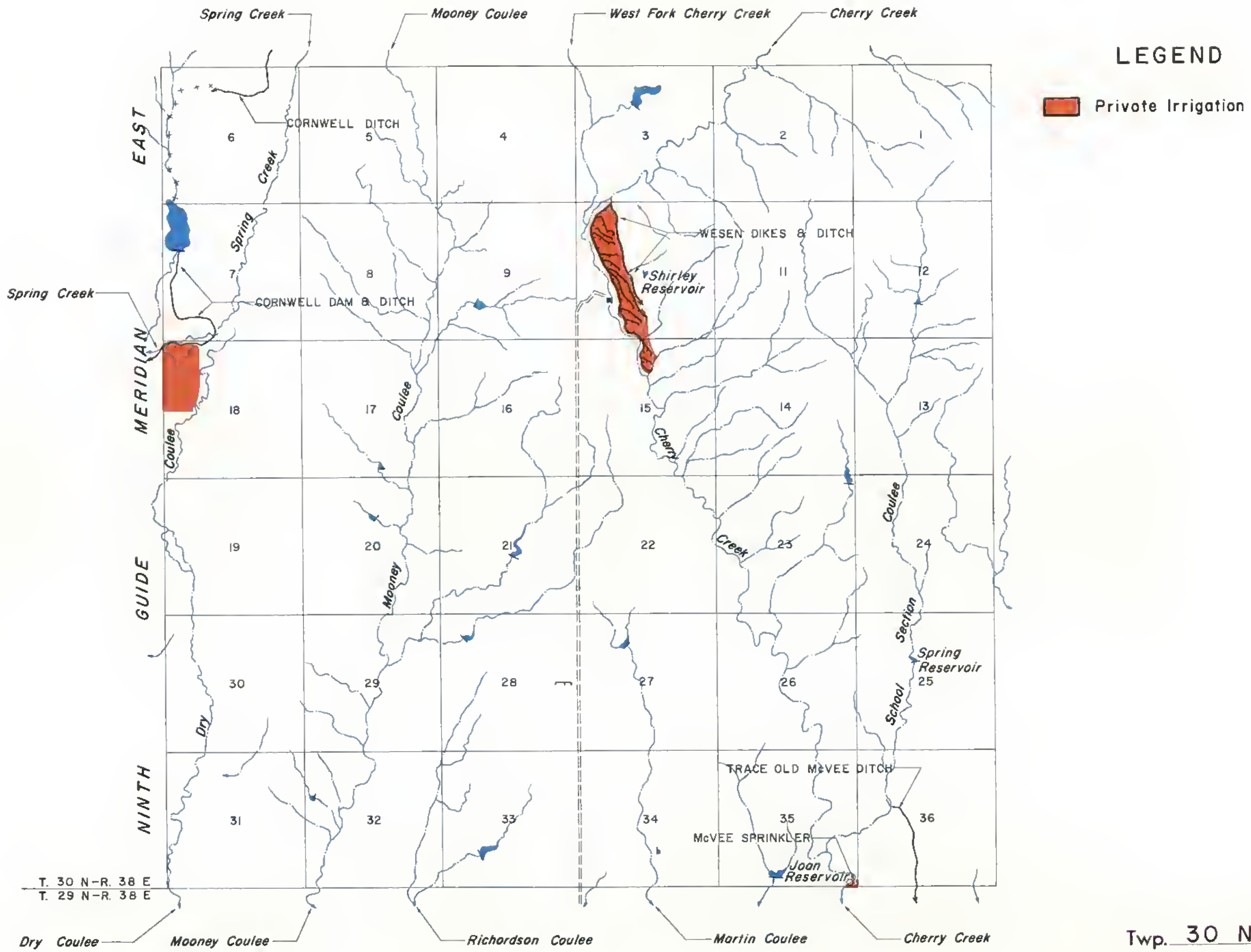


LEGEND
Glasgow Irrigation District
Private Irrigation
Chapman Coulee
Mooney Coulee
Richardson Coulee
Martin Coulee
Cherry Creek
McVEE PUMPS & SPRINKLERS
FOUST DIKES
Foss Coulee
ANDERSON DIKES & DAMS
G. N. R. R.
East Fork Cherry Creek
KOLSTAD DIKES
Drew Reservoir
COUNTRY CLUB PUMP & PIPELINE
DELAY DIKES & DITCH
POTTER PUMP & DITCH
Milk River
SWENSON PUMP & DITCH
MAAG PUMPS & DITCHES
KNIERIM PUMP & DITCHES
TRACE OLD JONES DITCH
GLASGOW AIRPORT
EAST MERIDIAN
GUIDE
NINTH
SEVENTH STANDARD PARALLEL NORTH
T. 29 N-R. 38 E
T. 28 N-R. 39 E
Squaw Coulee
Rock Coulee
Crossing Creek
Richardson Coulee
Martin Coulee
Cherry Creek
Twp. 29 North
Rge. 39 East



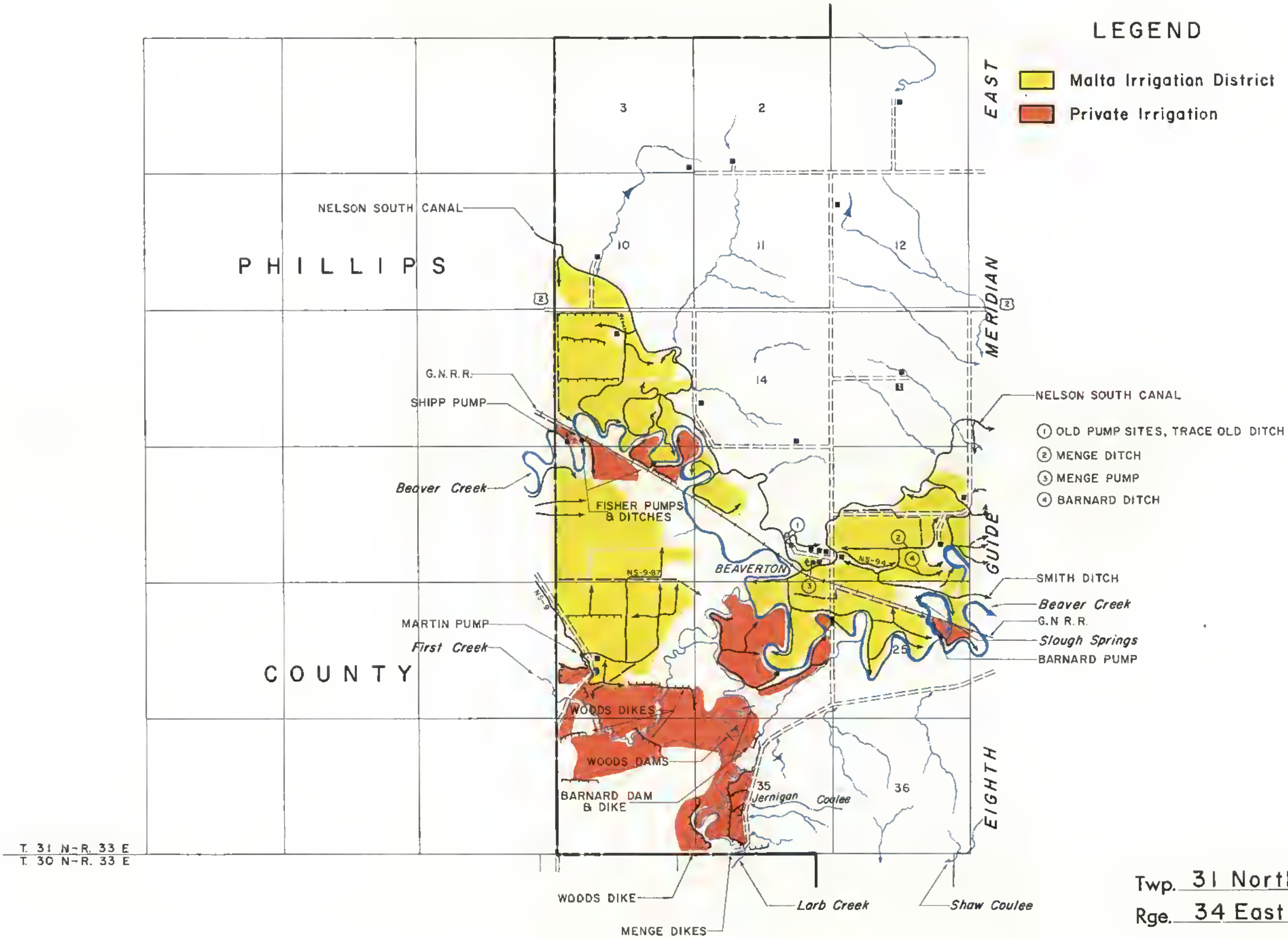
LARSEN PUMP & DITCH
HELLSTERN DITCH
BLACK DITCH
ROCK CREEK CANAL
Milk River
Middle Coulee
OPHUS DITCHES
Milk River
RUTTER DITCH
G.N.R.R.
HINSDALE
Black Slough
HINSDALE WELL HOUSE
HELLSTERN PUMP
RUTTER PUMP
BETZ PUMP & DITCH
Milk River
Big Coulee
Middle Coulee
Kent Coulee
Tank Coulee
Ash
Klind Reservoirs
Ash Coulee
West Fork Ash Coulee
W. Fk. Ash Coulee
Coulee
U.S.B.R. DITCH & DIKE
VANDALIA DAM
G.N.R.R.
Ash Coulee
Buffalo Coulee
UOBERG DAMS-DITCH & DIKE
Abel
Snow Coulee
Coulee
T. 30 N-R. 35 E
T. 29 N-R. 35 E
McGregor Coulee
Smiley Coulee
Mott Coulee
South Fork Traux Coulee
Traux Coulee
LEGEND
Rock Creek Canal Co.
Private Irrigation
Twp. 30 North
Rge. 36 East


LEGEND
Glasgow Irrigation District
Private Irrigation
WAGNER DITCH
Unger Coulee
Buggy Creek
TRACE OLD DITCH
CORNWELL DITCH
Big Spring Coulee
Spring Coulee
CAIN DAM & DITCH
Gravel Coulee
Milk River
NELSON DIKE
REID DITCH
CORNWELL DAM & DITCHES
VANDALIA SOUTH CANAL
Milk
River
Antelope
Creek
Antelope Spring
G.N.R.R.
T. 30 N - R. 37 E
T. 29 N - R. 37 E
VANDALIA SOUTH CANAL
ENKERUD PUMPS & DITCHES
CORNWELL PUMP & DITCH
Milk River
SORESON & NELSON PUMP & DITCH
ETCHART DITCH
MILLER PUMP & DITCHES
EAST MERIDIAN
GUIDE
NINTH
1 2 3 4 5 6
7 8 9 10 11 12
13 16 17
19 20 21 22 23 24
26 27 28 29 30
32 34 35 36
Twp. 30 North
Rge. 38 East



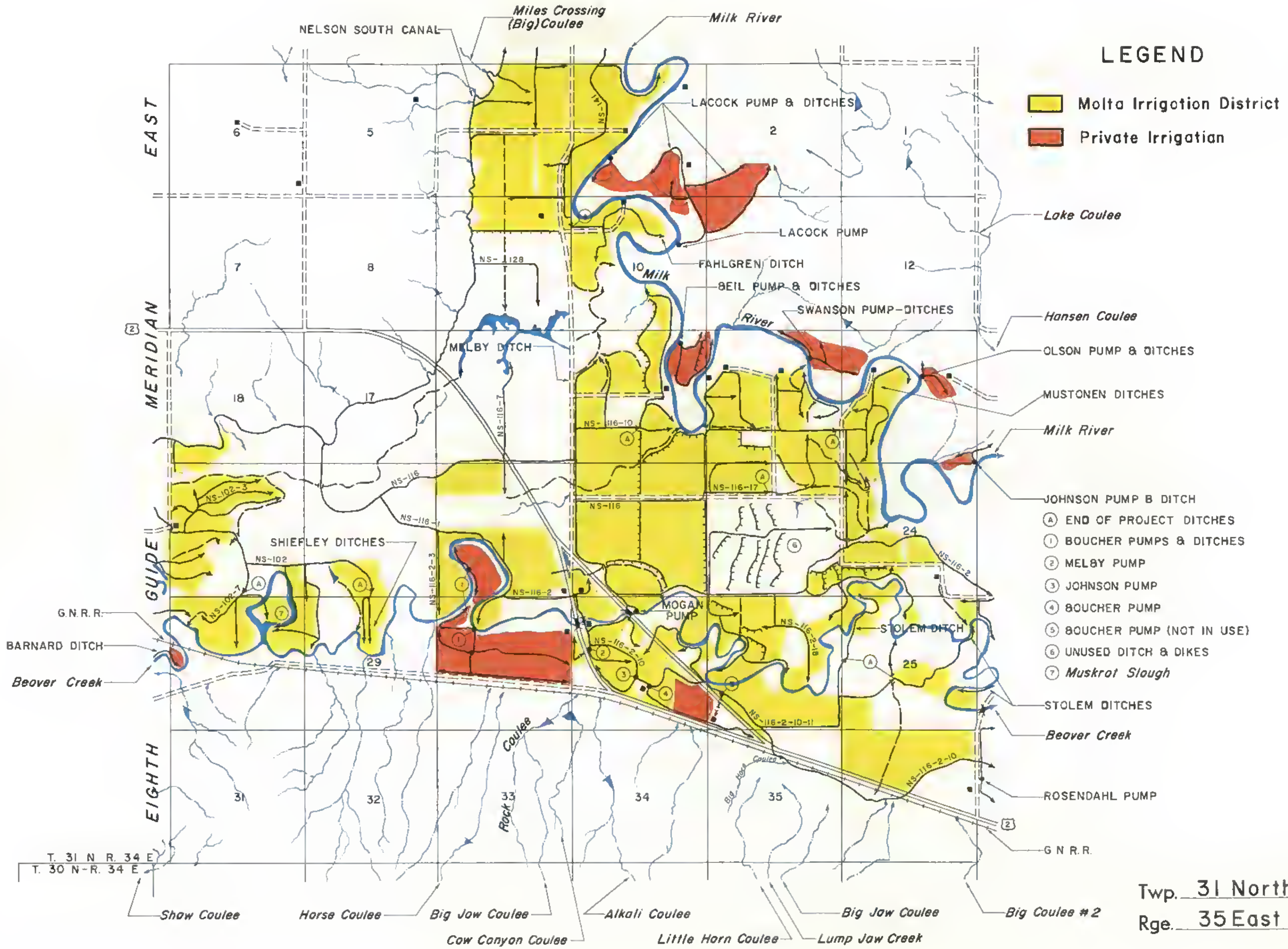
Twp. 30 North

Rge. 39 East

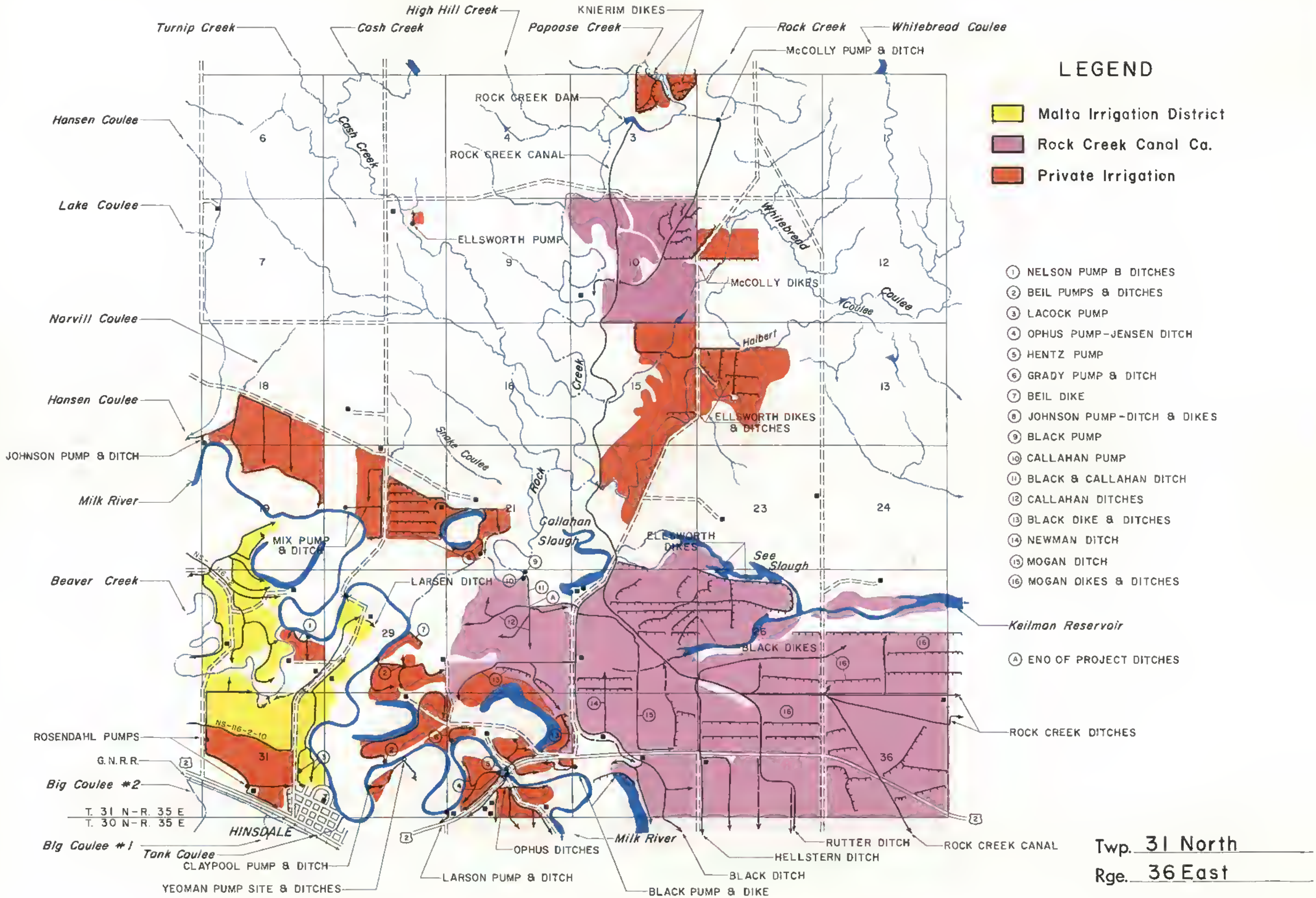


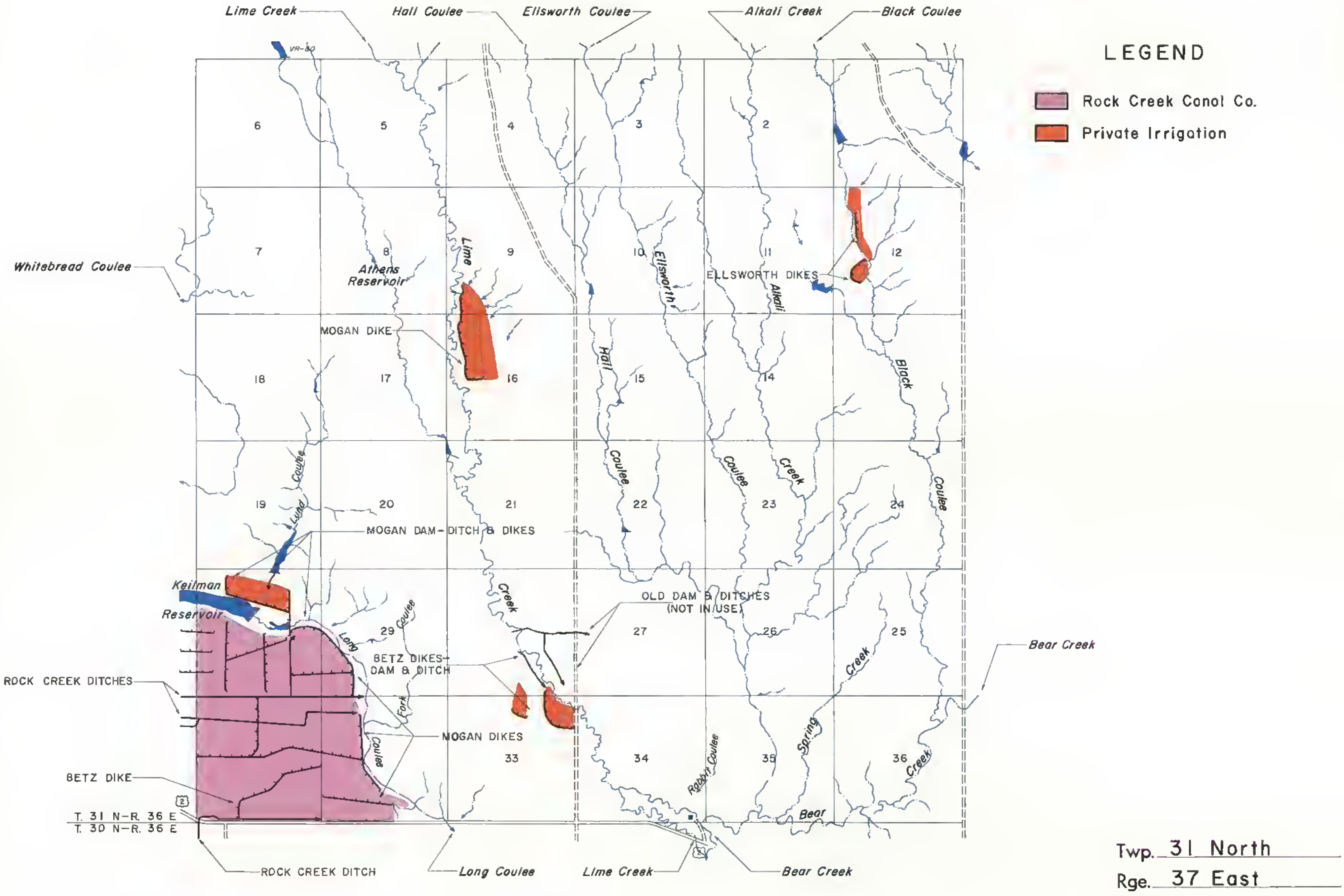
Twp. 31 North

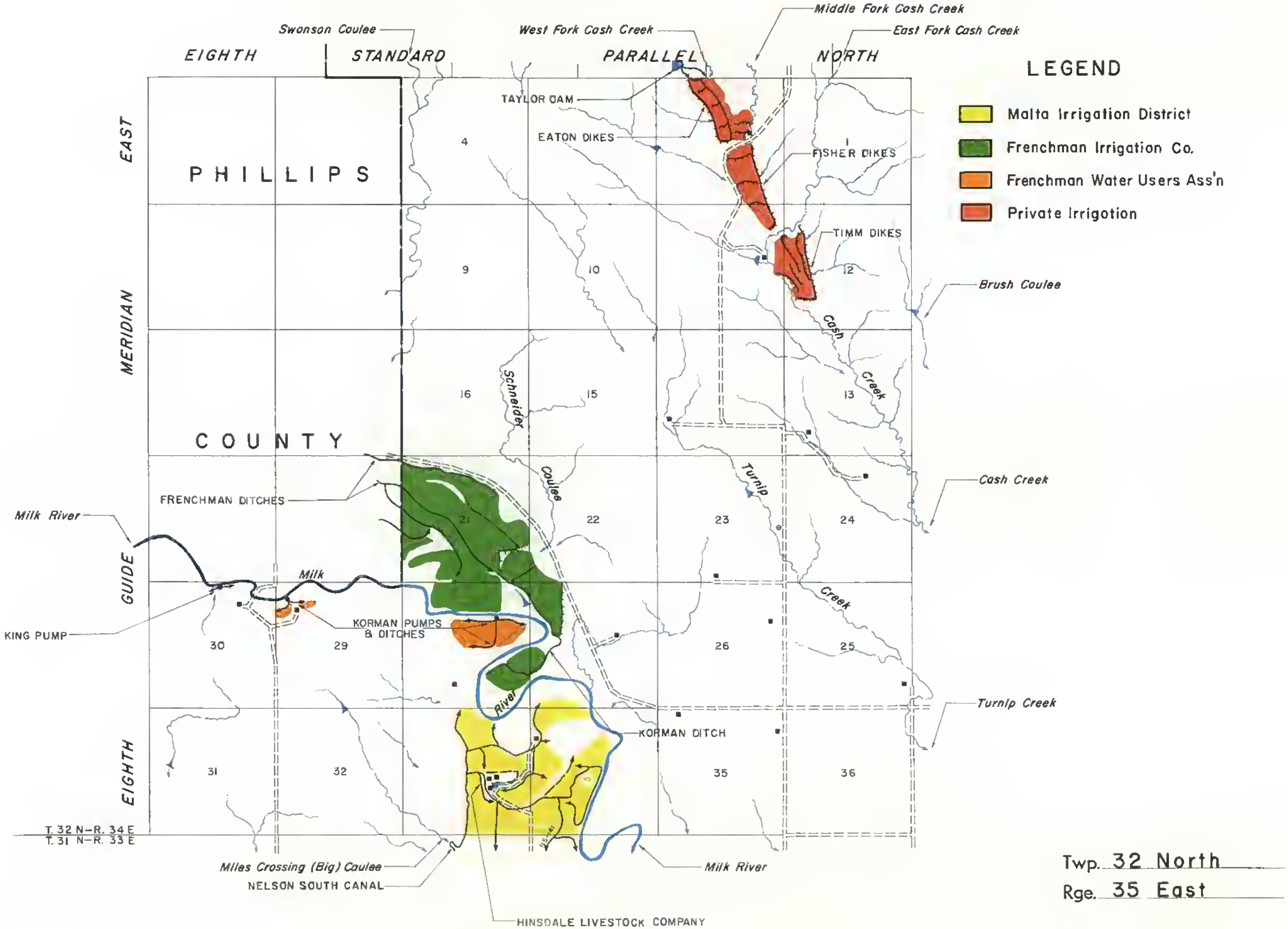
Rge. 34 East

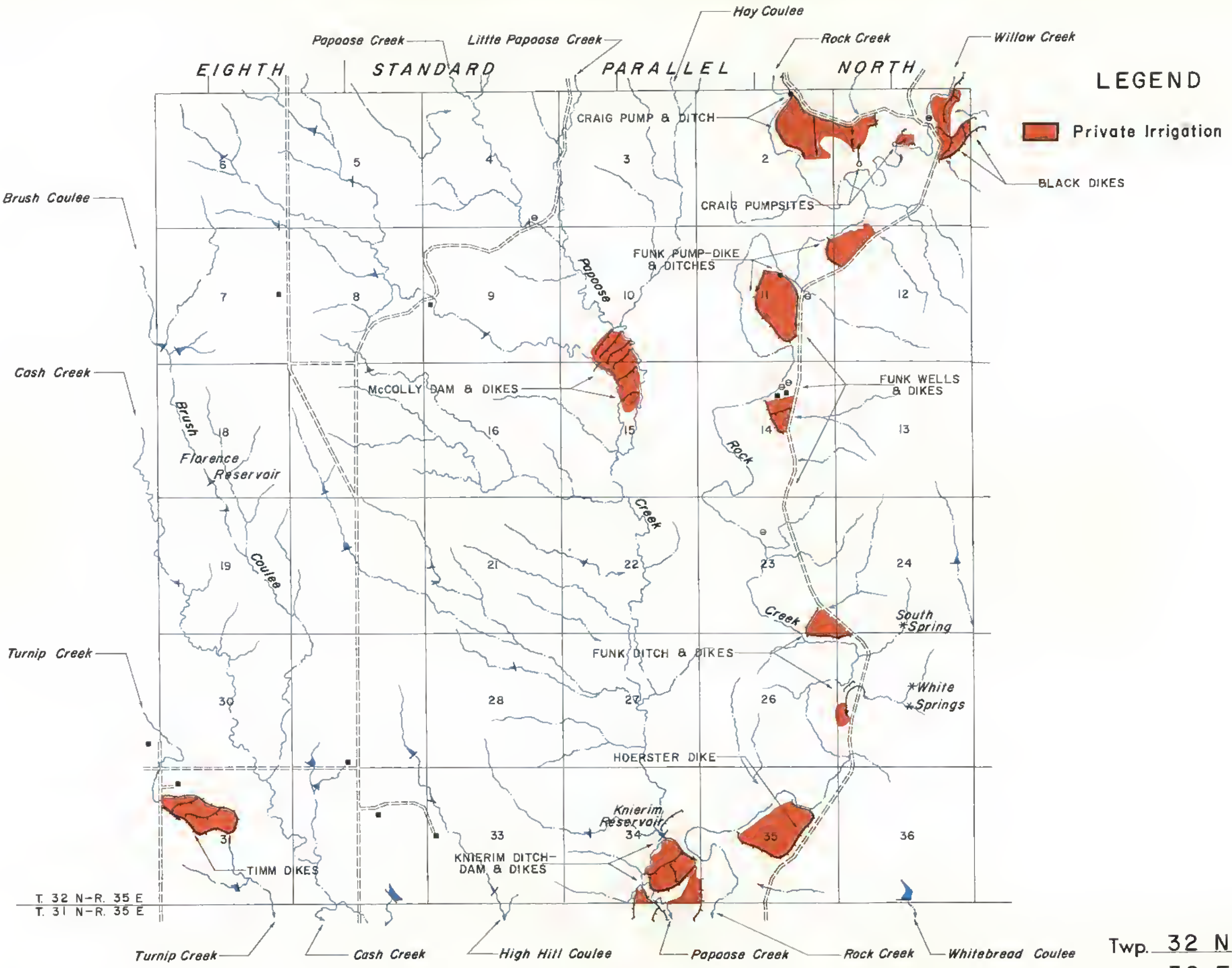


Twp. 31 North
Rge. 35 East


LEGEND
Malta Irrigation District
Rock Creek Canal Co.
Private Irrigation
(1) NELSON PUMP & DITCHES
(2) BEIL PUMPS & DITCHES
(3) LACOCK PUMP
(4) OPHUS PUMP-JENSEN DITCH
(5) HENTZ PUMP
(6) GRADY PUMP & DITCH
(7) BEIL DIKE
(8) JOHNSON PUMP-DITCH & DIKES
(9) BLACK PUMP
(10) CALLAHAN PUMP
(11) BLACK & CALLAHAN DITCH
(12) CALLAHAN DITCHES
(13) BLACK DIKE & DITCHES
(14) NEWMAN DITCH
(15) MOGAN DITCH
(16) MOGAN DIKES & DITCHES
(A) END OF PROJECT DITCHES
Turnip Creek
Cash Creek
High Hill Creek
Papoose Creek
KNIERIM DIKES
Rock Creek
Whitebread Coulee
McCOLLY PUMP & DITCH
ROCK CREEK DAM
ROCK CREEK CANAL
ELLSWORTH PUMP
McCOLLY DIKES
ELLSWORTH DIKES & DITCHES
ELLSWORTH DIKES
Hansen Coulee
Lake Coulee
Norvill Coulee
Hansen Coulee
JOHNSON PUMP & DITCH
Milk River
Beaver Creek
MIX PUMP & DITCH
LARSEN DITCH
Snake Coulee
Callahan Slough
See Slough
Holbert
Coulee
Keilman Reservoir
BLACK DIKES
ROCK CREEK DITCHES
ROSENDAHL PUMPS
G.N.R.R.
Big Coulee #2
T. 31 N-R. 35 E
T. 30 N-R. 35 E
HINSDALE
Big Coulee #1
Tank Coulee
CLAYPOOL PUMP & DITCH
YEOMAN PUMP SITE & DITCHES
LARSON PUMP & DITCH
OPHUS DITCHES
Milk River
BLACK PUMP & DIKE
BLACK DITCH
HELLSTERN DITCH
RUTTER DITCH
ROCK CREEK CANAL
NS-116-2-10
Twp. 31 North
Rge. 36 East

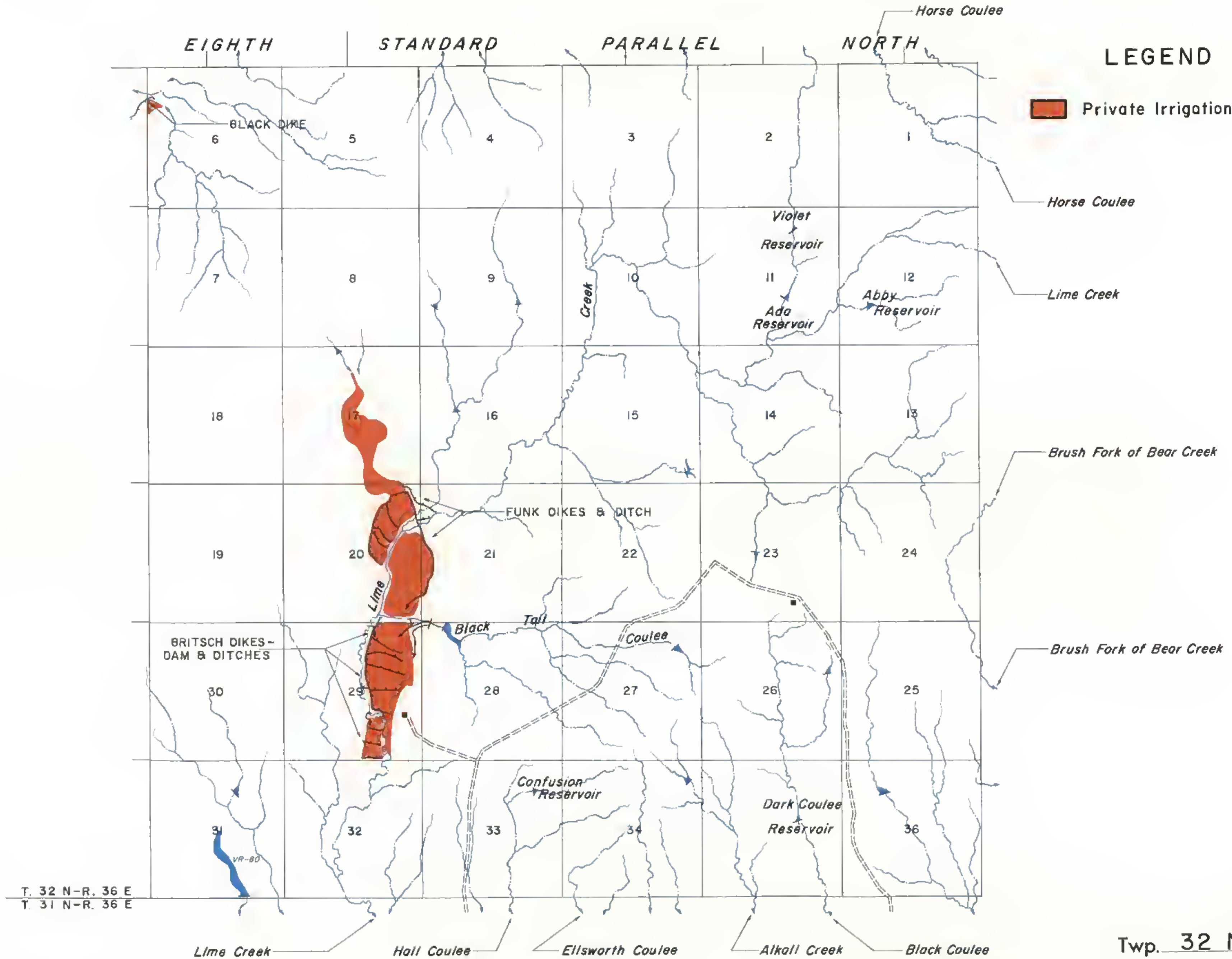

Lime Creek
Hall Coulee
Ellsworth Coulee
Alkali Creek
Black Coulee
LEGEND
Rock Creek Canal Co.
Private Irrigation
Whitebread Coulee
Athens Reservoir
MOGAN DIKE
ELLSWORTH DIKES
Lime
Ellsworth
Alkali
Hall
Black
Coulee
Lund
Coulee
Coulee
Creek
Coulee
MOGAN DAM-DITCH & DIKES
Keilman
Reservoir
Creek
OLD DAM & DITCHES
(NOT IN USE)
Long
Coulee
BETZ DIKES-
DAM & DITCH
Bear Creek
Creek
ROCK CREEK DITCHES
Fork
MOGAN DIKES
Coulee
Spring
Rabbit Coulee
Creek
BETZ DIKE
Bear
T. 31 N-R. 36 E
T. 30 N-R. 36 E
ROCK CREEK DITCH
Long Coulee
Lime Creek
Bear Creek
Twp. 31 North
Rge. 37 East


Swonson Coulee
West Fork Cash Creek
Middle Fork Cash Creek
East Fork Cash Creek
EIGHTH STANDARD PARALLEL NORTH
EAST MERIDIAN GUIDE
EIGHTH
PHILLIPS COUNTY
TAYLOR DAM
EATON DIKES
FISHER DIKES
TIMM DIKES
Brush Coulee
Cash Creek
Schneider Coulee
Turnip Creek
Milk River
Milk River
FRENCHMAN DITCHES
KING PUMP
KORMAN PUMPS & DITCHES
KORMAN DITCH
Miles Crossing (Big) Coulee
NELSON SOUTH CANAL
HINSDALE LIVESTOCK COMPANY
Turnip Creek
Cash Creek
T. 32 N–R. 34 E
T. 31 N–R. 33 E
LEGEND
Malta Irrigation District
Frenchman Irrigation Co.
Frenchman Water Users Ass'n
Private Irrigation
Twp. 32 North
Rge. 35 East



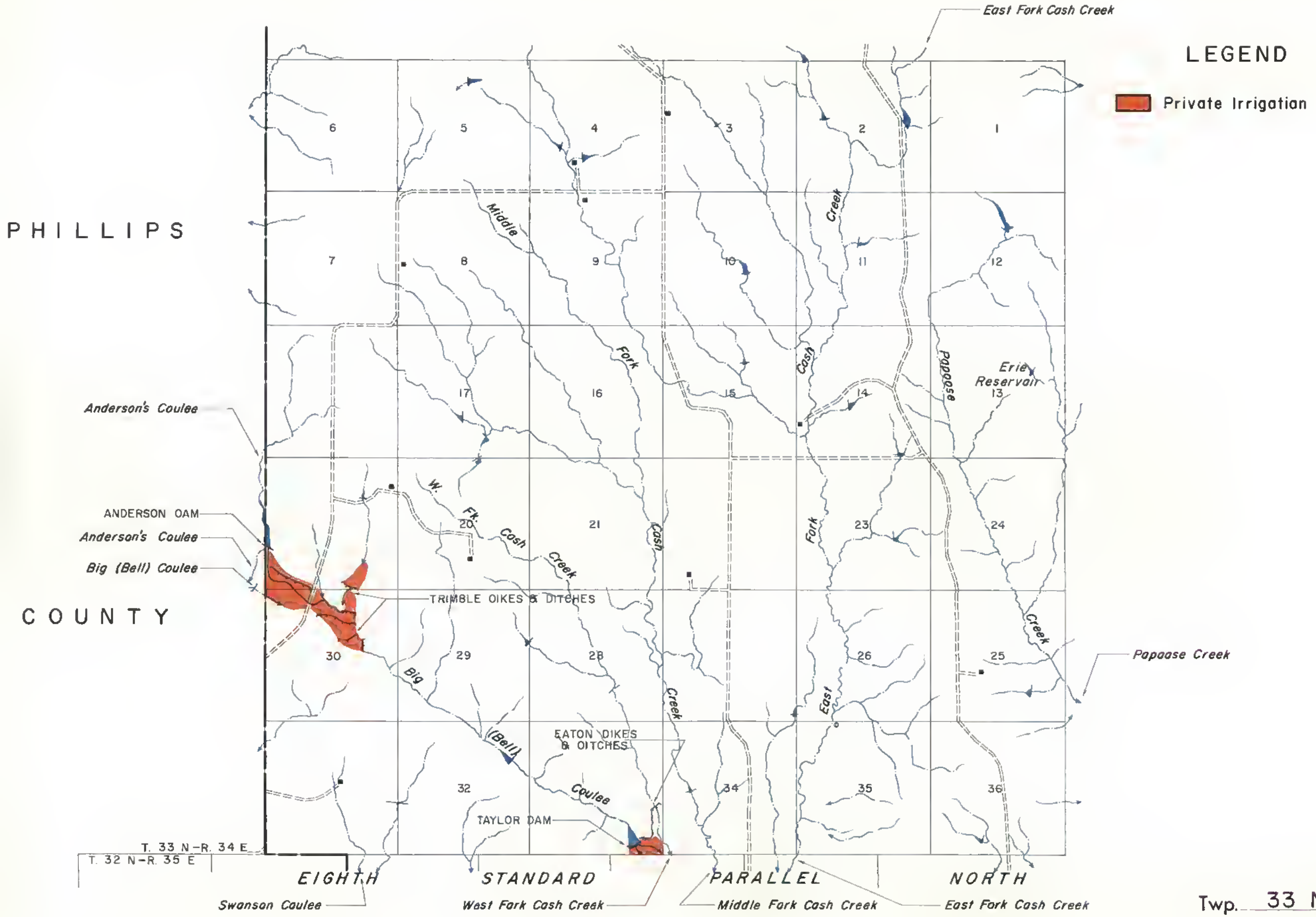
Twp. 32 North

Rge. 36 East

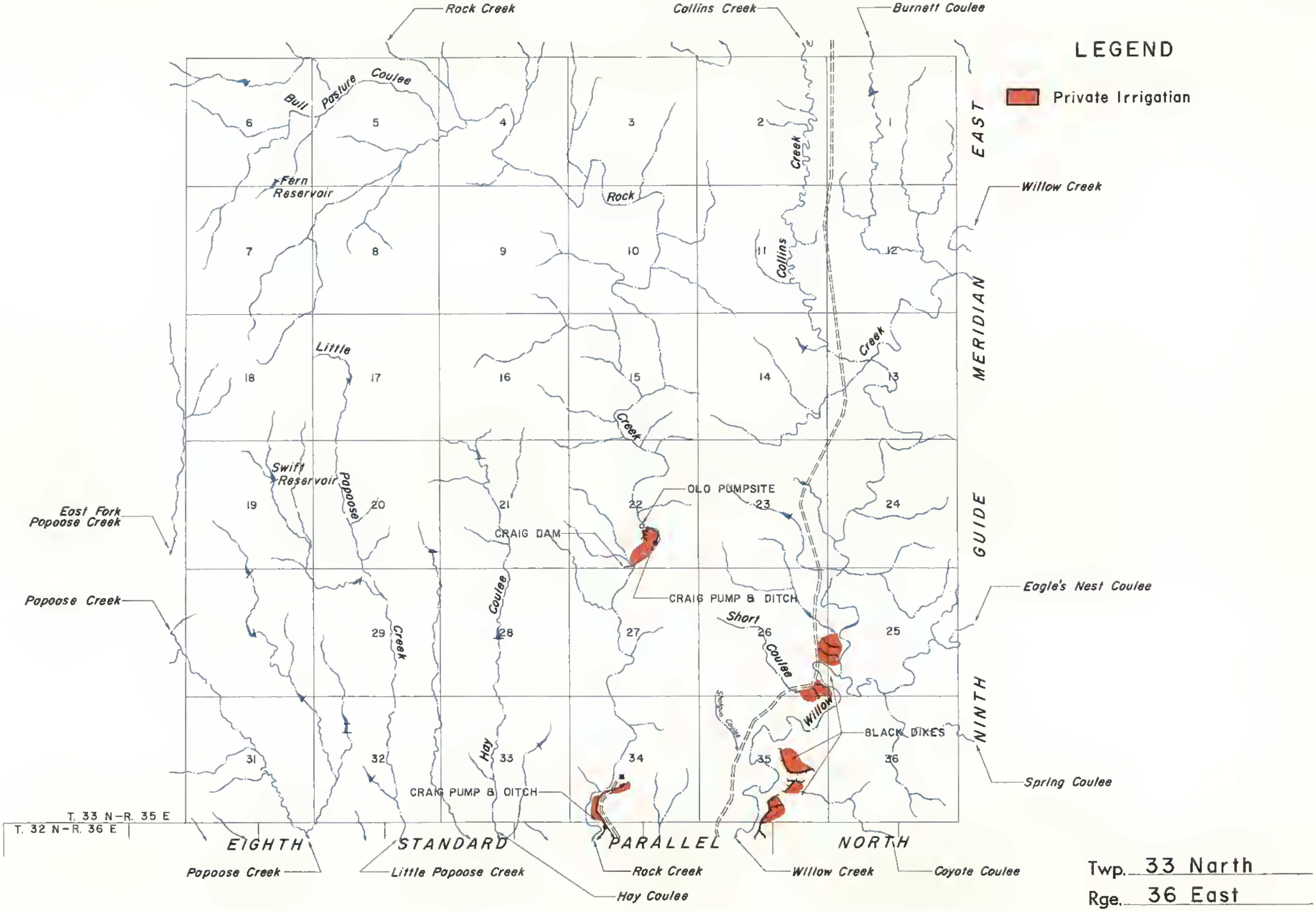


Twp. 32 North

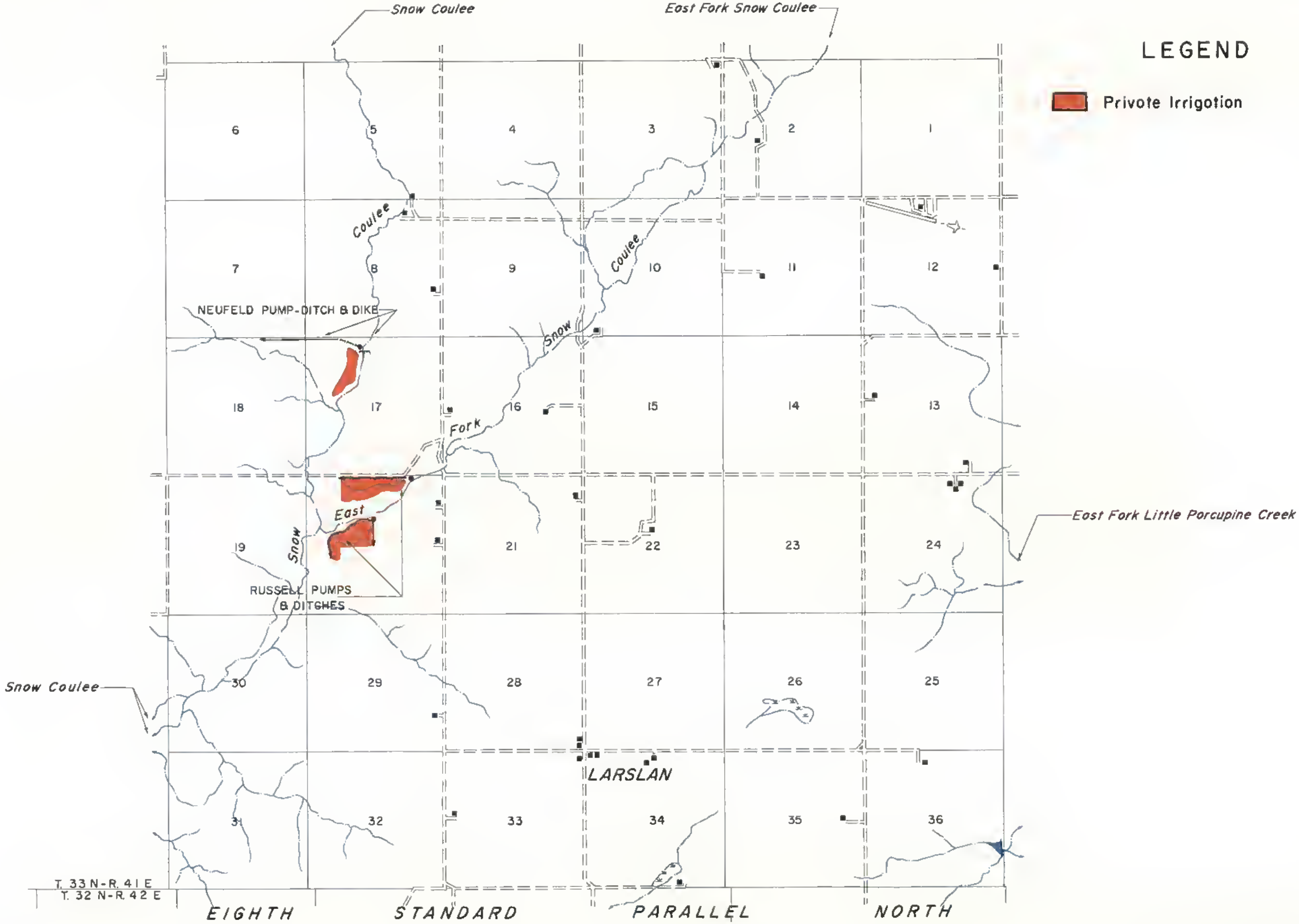
Rge. 37 East



Twp. 33 North
Rge. 35 East

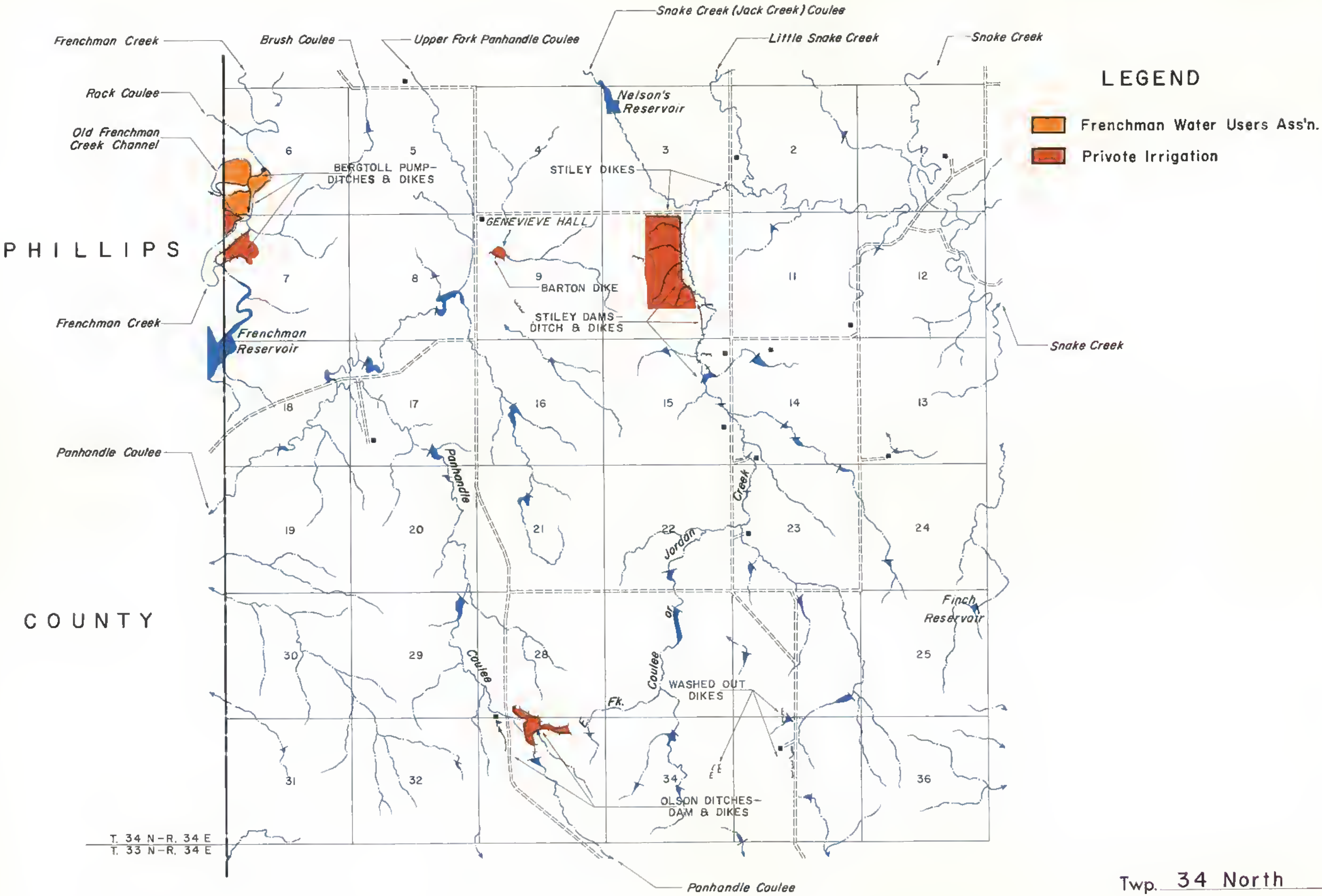


LEGEND
Private Irrigation
Rock Creek
Collins Creek
Burnett Coulee
Bull Pasture Coulee
Fern Reservoir
Rock
Creek
Collins Creek
Willow Creek
Creek
Little
Swift Reservoir
Popoose
OLD PUMPSITE
CRAIG DAM
CRAIG PUMP & DITCH
East Fork Popoose Creek
Papoose Creek
Coulee
Creek
Short Coulee
Eagle's Nest Coulee
Willow
BLACK DIKES
Hay
CRAIG PUMP & DITCH
Spring Coulee
EAST MERIDIAN GUIDE NINTH
T. 33 N-R. 35 E
T. 32 N-R. 36 E
EIGHTH STANDARD PARALLEL NORTH
Papoose Creek
Little Papoose Creek
Hay Coulee
Rock Creek
Willow Creek
Coyote Coulee
Twp. 33 North
Rge. 36 East



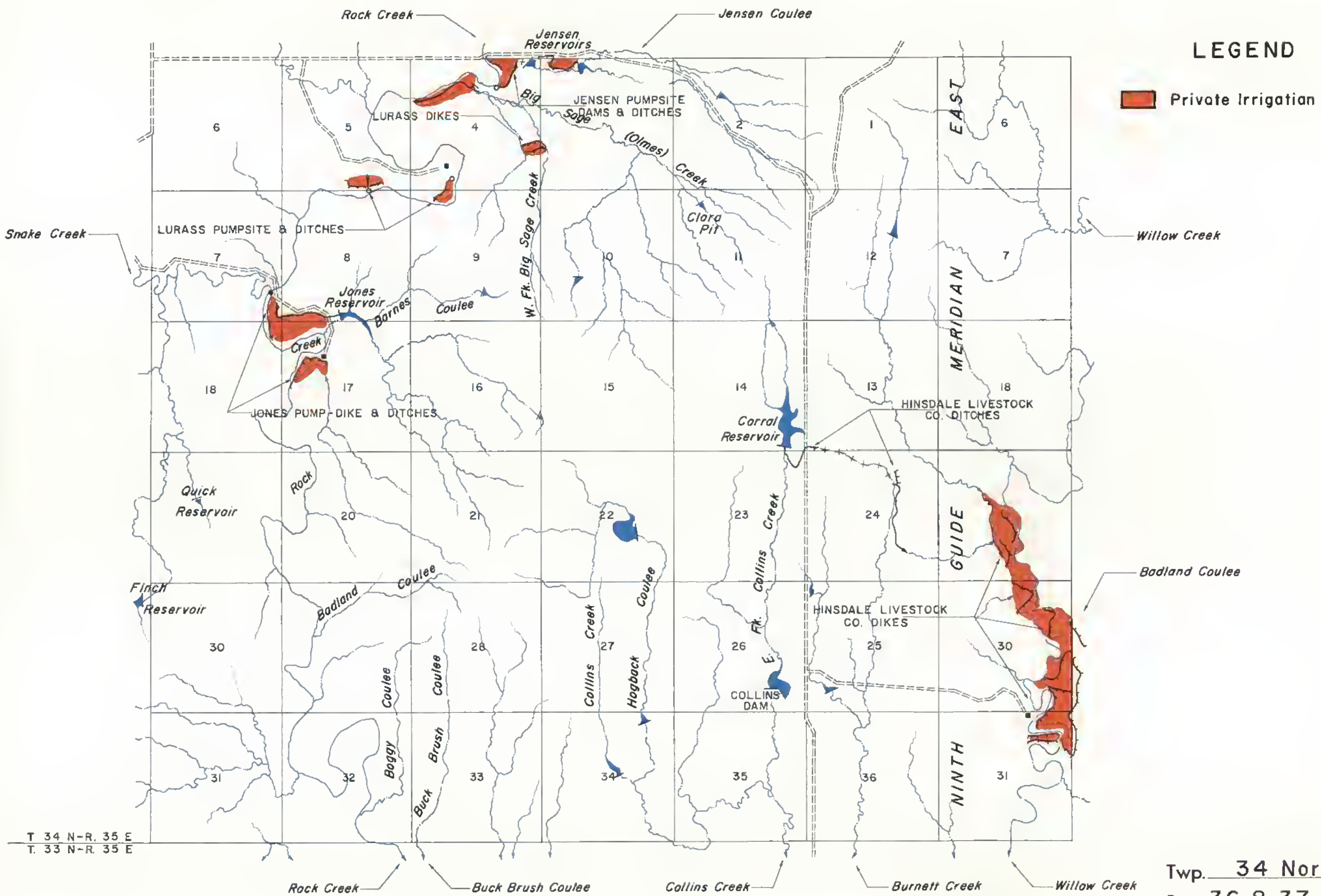
Twp. 33 North

Rge. 42 East



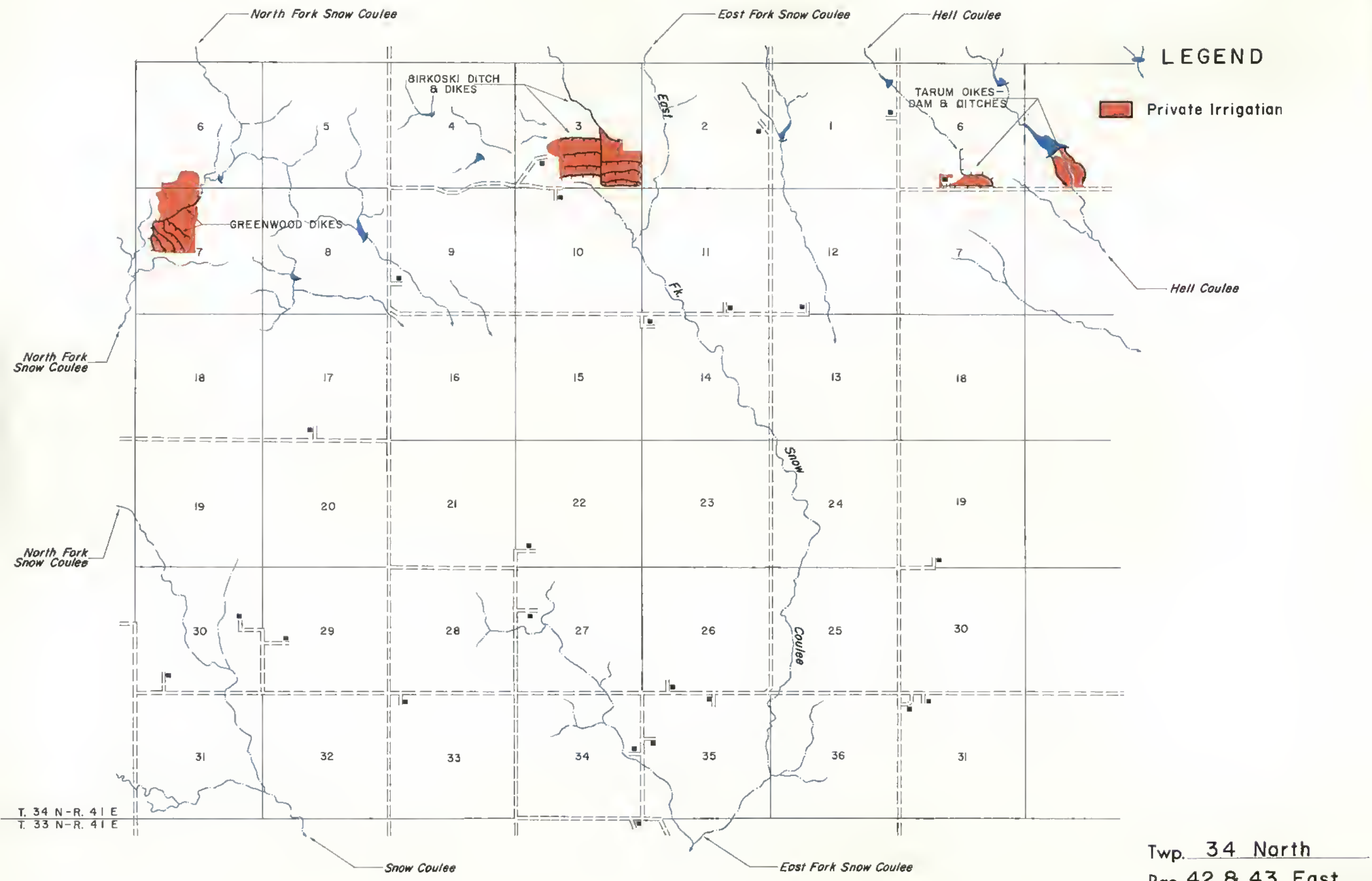
Twp. 34 North

Rge. 35 East



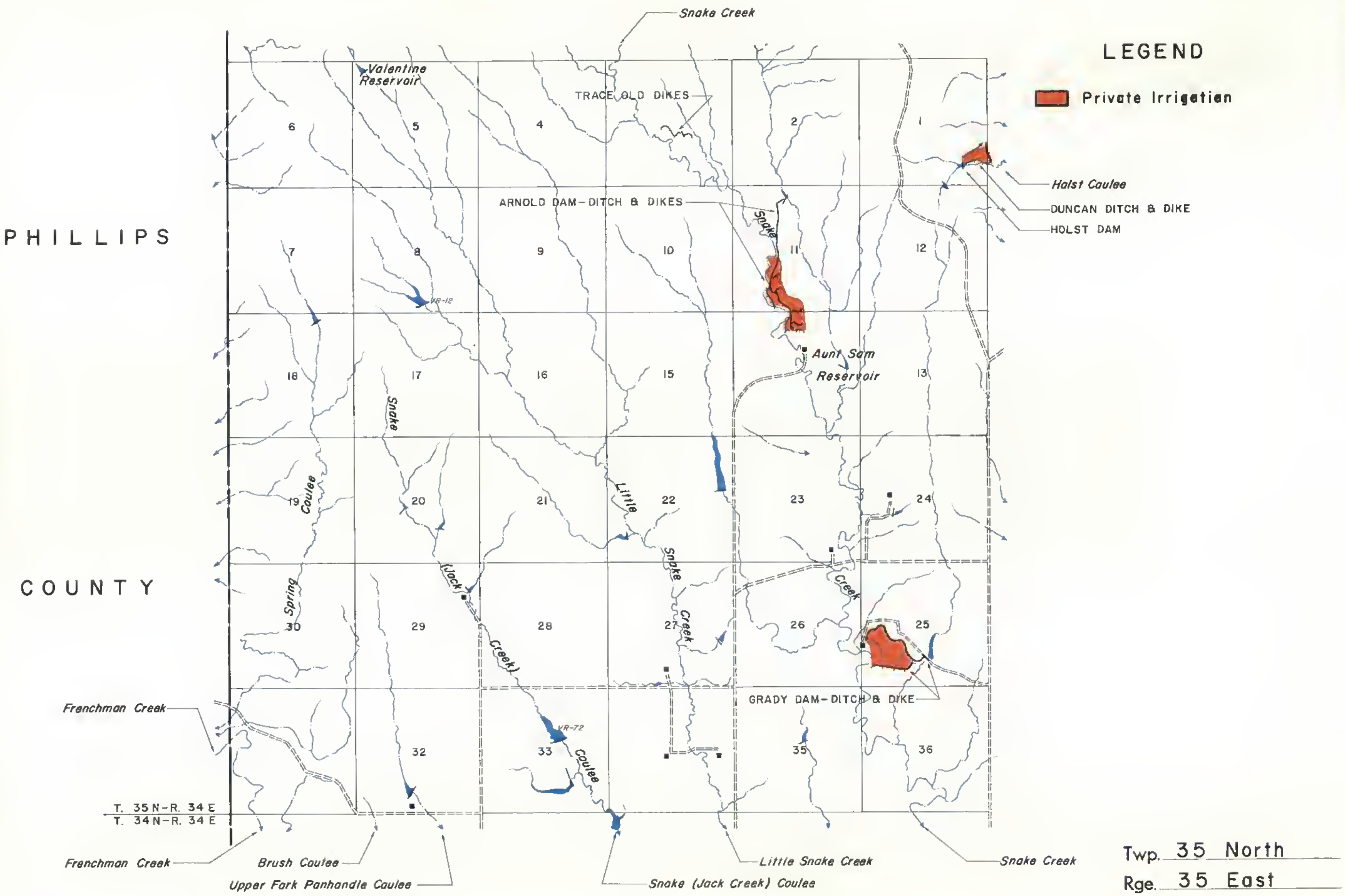
Twp. 34 North

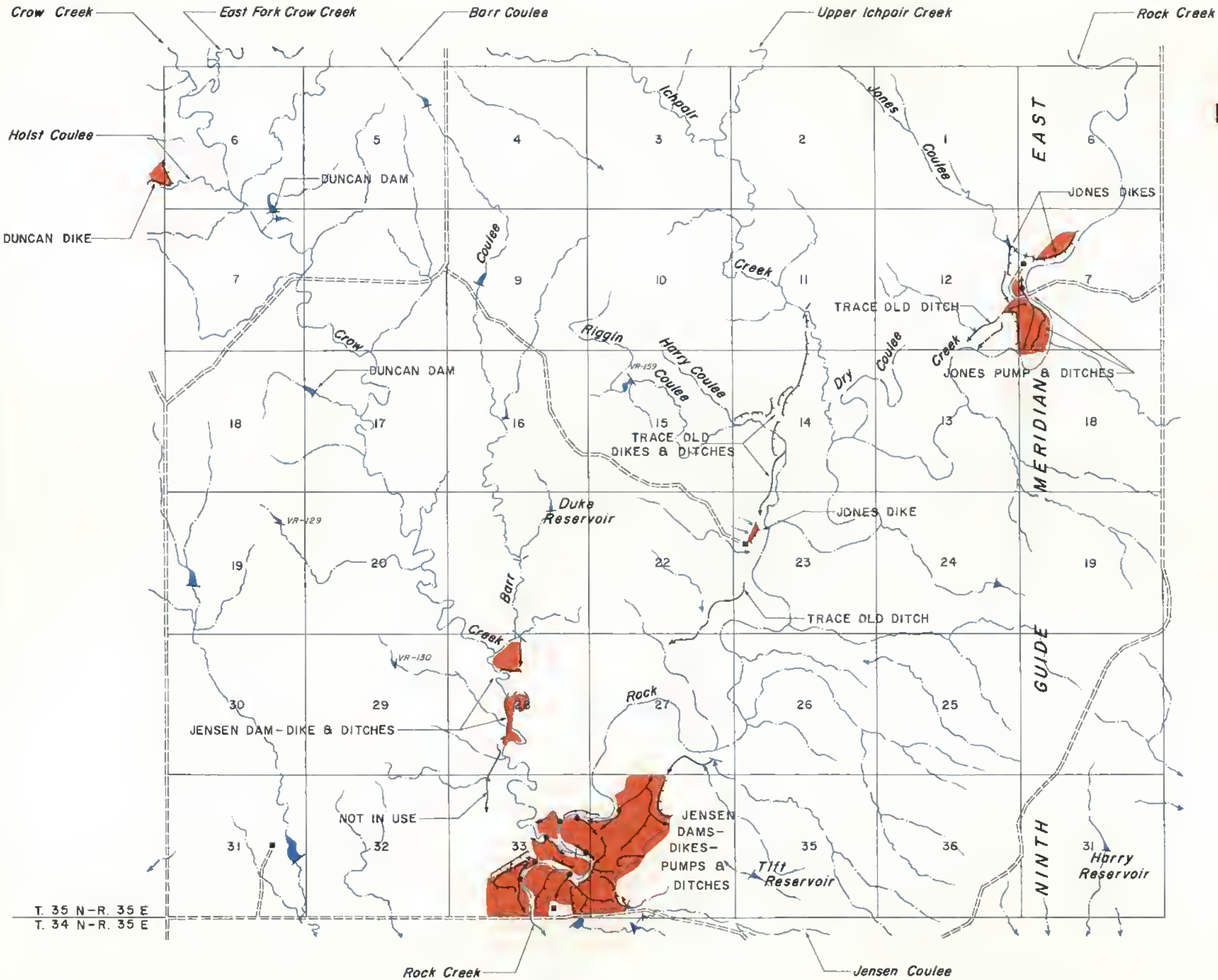
Rge. 36 & 37 East



Twp. 34 North

Rge. 42 & 43 East


LEGEND
Private Irrigation
Snake Creek
Valentine Reservoir
TRACE OLD DIKES
ARNOLD DAM-DITCH & DIKES
Halst Caulee
DUNCAN DITCH & DIKE
HOLST DAM
Aunt Sam Reservoir
PHILLIPS
COUNTY
Spring Coulee
Snake
Jack Creek
Coulee
Little Snake Creek
Snake Creek
GRADY DAM-DITCH & DIKE
Frenchman Creek
T. 35 N-R. 34 E
T. 34 N-R. 34 E
Frenchman Creek
Brush Coulee
Upper Fork Panhandle Coulee
Snake (Jack Creek) Coulee
Little Snake Creek
Snake Creek
VR-12
VR-72
Twp. 35 North
Rge. 35 East

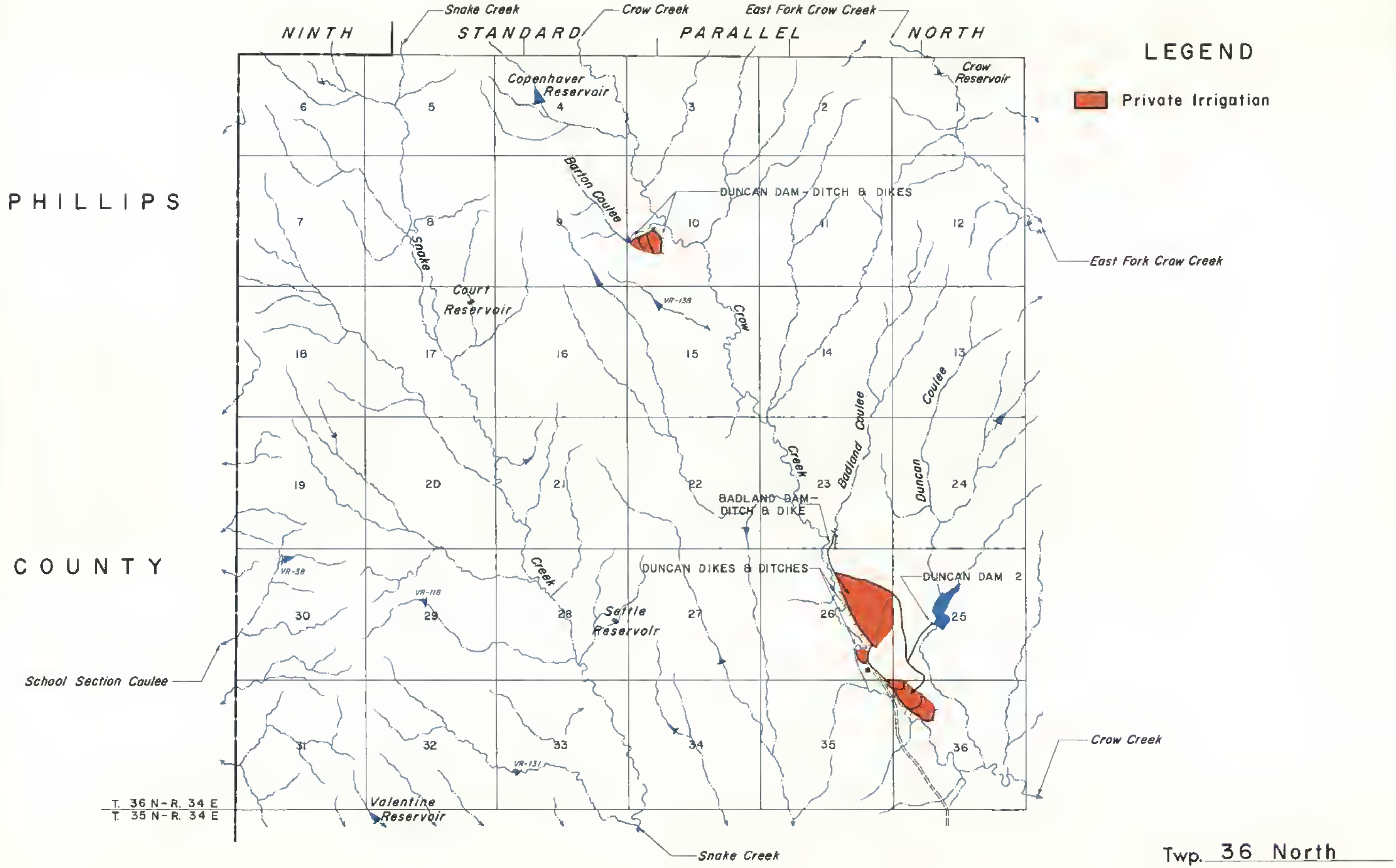


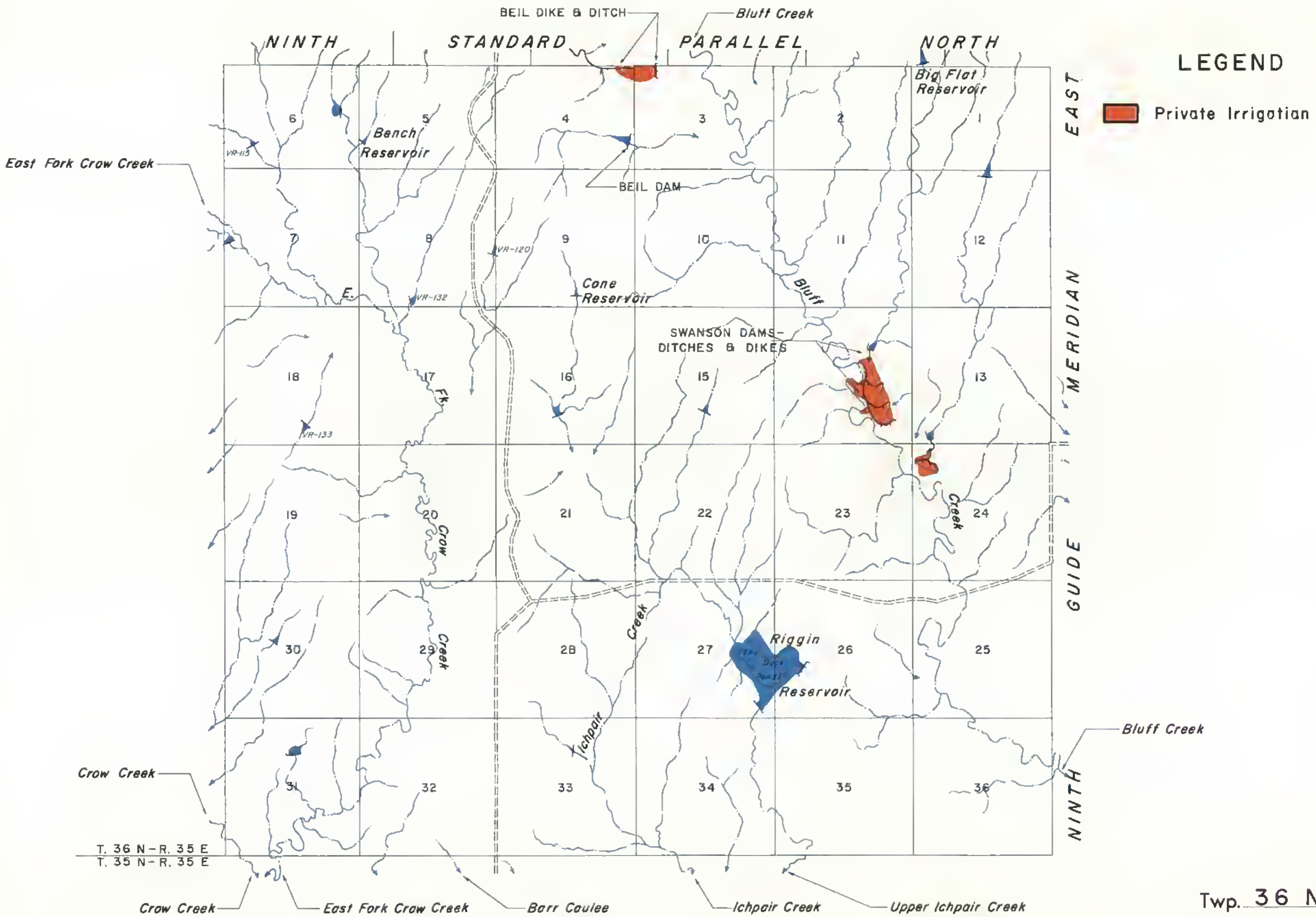
LEGEND

Private Irrigation

Twp. 35 North

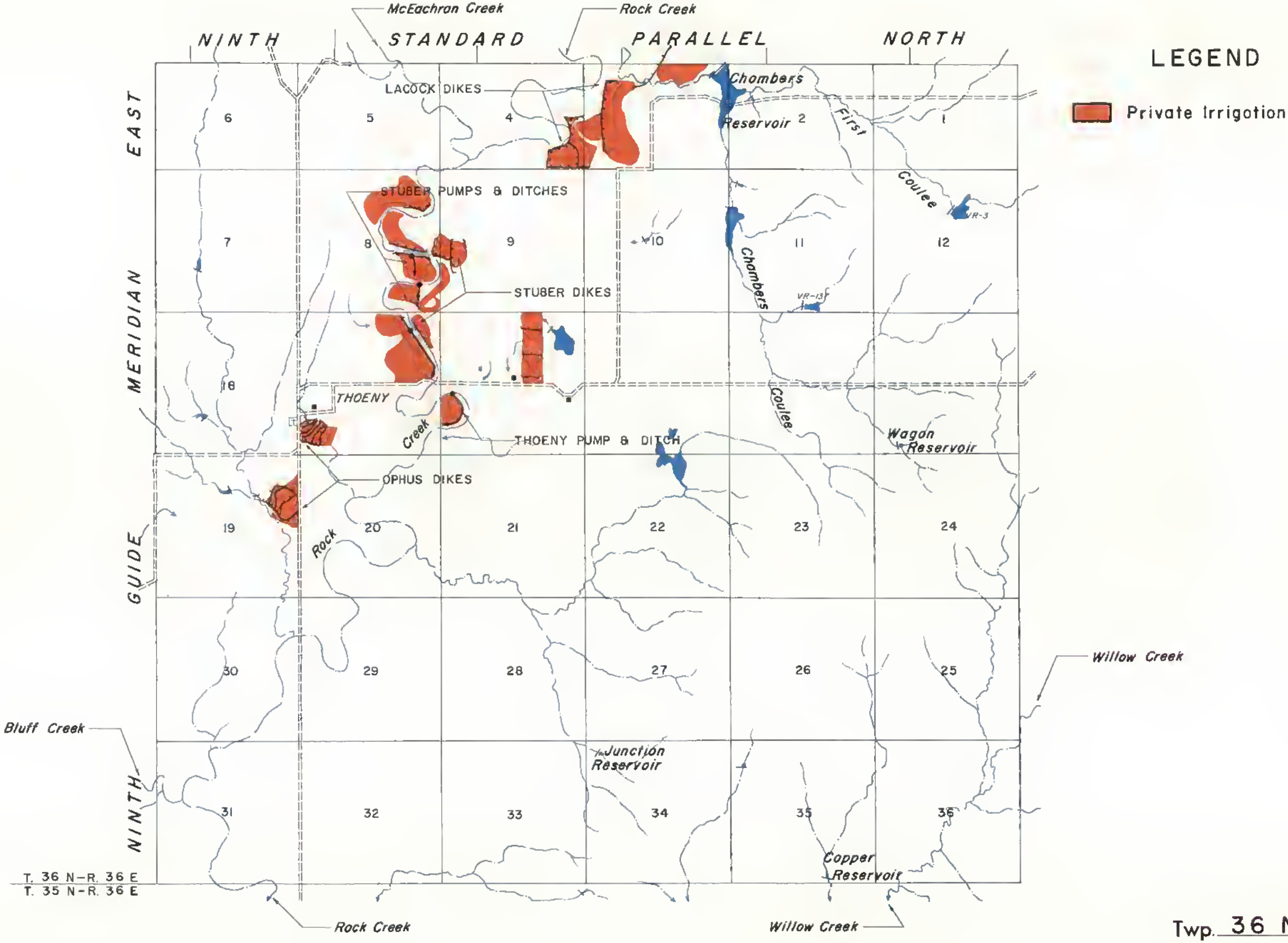
Rge. 36 & 37 East


NINTH STANDARD PARALLEL NORTH
Snake Creek
Crow Creek
East Fork Crow Creek
Copenhaver Reservoir
Crow Reservoir
Barton Coulee
DUNCAN DAM - DITCH & DIKES
East Fork Crow Creek
Snake
Court Reservoir
VR-138
Crow
Creek
Badland Coulee
Duncan Coulee
BADLAND DAM - DITCH & DIKE
DUNCAN DIKES & DITCHES
DUNCAN DAM 2
Creek
Settle Reservoir
VR-38
VR-118
VR-131
Valentine Reservoir
School Section Coulee
Crow Creek
Snake Creek
PHILLIPS
COUNTY
T. 36 N - R. 34 E
T. 35 N - R. 34 E
LEGEND
Private Irrigation
Twp. 36 North
Rge. 35 East



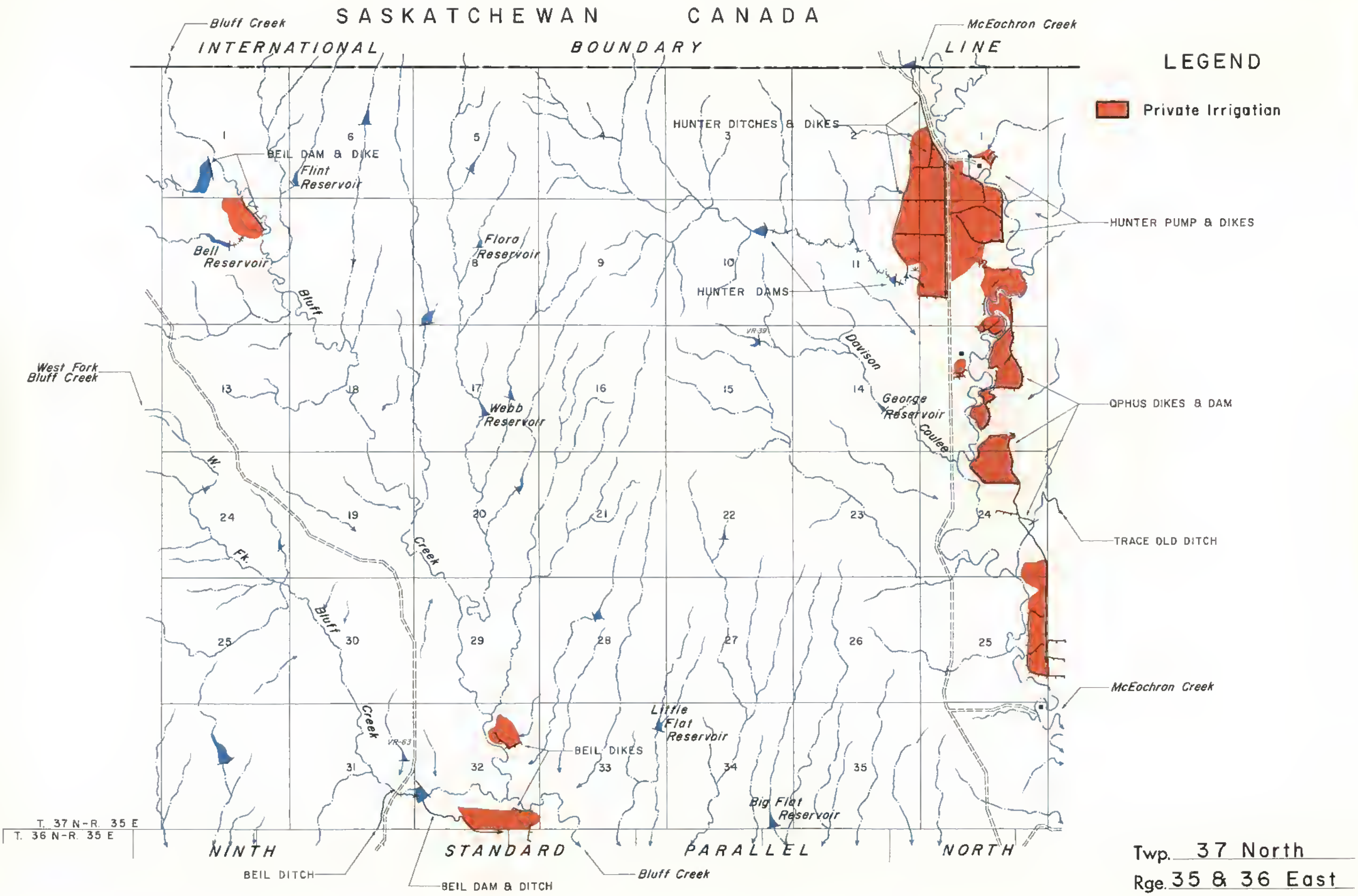
Twp. 36 North

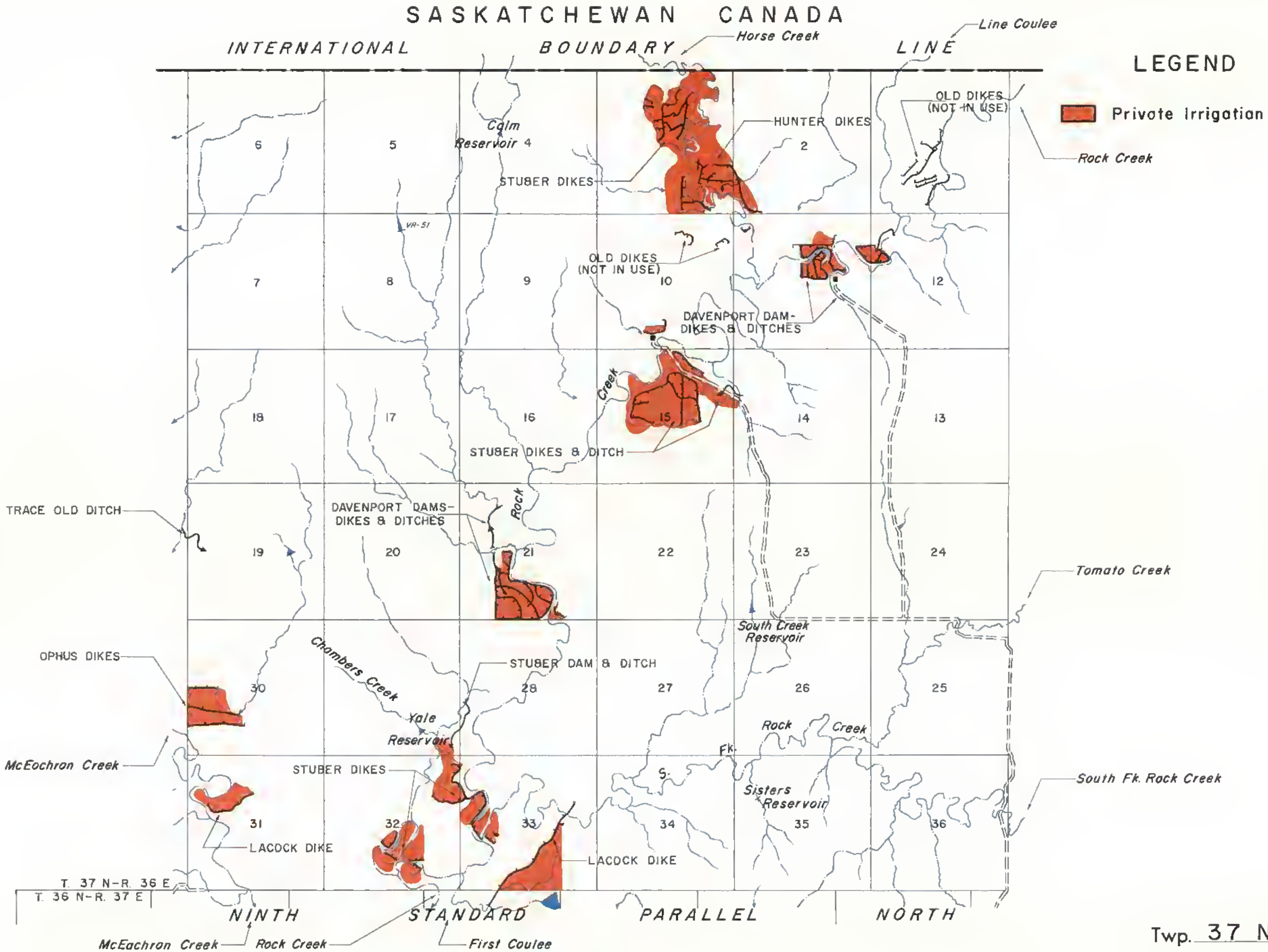
Rge. 36 East



Twp. 36 North

Rge. 37 East


SASKATCHEWAN CANADA
INTERNATIONAL BOUNDARY LINE
Bluff Creek
McEachron Creek
LEGEND
Private Irrigation
HUNTER DITCHES & DIKES
HUNTER PUMP & DIKES
BEIL DAM & DIKE
Flint Reservoir
Bell Reservoir
Flora Reservoir
HUNTER DAMS
West Fork Bluff Creek
Webb Reservoir
George Reservoir
Davison Coulee
OPHUS DIKES & DAM
TRACE OLD DITCH
W. Fk. Bluff Creek
McEochron Creek
Little Flat Reservoir
BEIL DIKES
Big Flat Reservoir
T. 37 N-R. 35 E
T. 36 N-R. 35 E
NINTH STANDARD PARALLEL NORTH
BEIL DITCH
BEIL DAM & DITCH
Bluff Creek
VR-39
VR-63
Twp. 37 North
Rge. 35 & 36 East



Twp. 37 North
Rge. 37 East